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Mondino de' Luzzi's commentary on the *Canones generales* of Mesuë the Younger

MONDINO, or more accurately RAIMONDO DE' LUZZI, son of NERINO FRANZOLI, was born in Bologna about the year 1270 (1). Like his father and several other members of the DE' LUZZI family, MONDINO started out in life as an apothecary, but as early as 1290 he was enrolled in the medical school at the university. His studies were directed by TADDEO ALDEROTTI, the great Florentine physician who was one of the founders of the medical school at Bologna. Having received his M.D. degree, by 1306 MONDINO had become one of the favorite professors in his university, where he continued to teach until 1326 (2), the year of his death.

Because a number of medical men and philosophers living in the fourteenth century bore the very common name of MONDINO (3), there is to-day some confusion concerning the authorship of various works appearing under this name, and thus MONDINO DE' LUZZI has not been given due credit for all his writings. In fact in most of his biographies, the *Anatomia* is the only work which is discussed, or in some cases the only one even ascribed to him (4).

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(1) LINO SIGHINOLOFI, *Mondino de' Liucci, Anatomia* (Preface, 1-22, Bologna 1930). M. SARTI and M. FATTORINI, *De claris archigymnasii Bononiensis professoribus*, reëdited by C. ALBICINI, and C. MALAGOLA (I, 551, Bologna 1883-1886). H. HAESER, *Lehrbuch des Geschichte der Medicin* (1, 737-744, Jena 1895).

(2) Cronica de Bologna, in L. A. MURATORI, *Rerum italicarum scriptores* (XVIII, col. 340, Milan 1731). L. FRATI, Ricerche sull' anatomico Mondino, in *Rivista di storia critica delle scienze* (I, 156, 1912), a brief note on the date of his death.

(3) MONDINO DE' LUZZI must not be confused with a MONDINO DE FORLI, likewise a Bolognese physician, nor with another MONDINO DE' LUZZI of Bologna who was a philosopher, nor with MONDINO DA CIVIDALE DEL FRIULI.

(4) "Save for his text book (the *Anatomia*), this 'tomb of the Masters Leuci and Mondino de' Luzzi—' is the sole monument to our author, the authenticity

MONDINO DE' LUZZI himself, frequently cites in his *Anatomia*, his earlier *Lectura super primo, secundo, tertio et quarto de juvamentis* of GALEN. Other *Consilia* are listed by BALDUIN VONDERLAGE, and include such titles as *Tractatus de dosi medicinae*, *Practicae medicinae* and many others, showing that MONDINO was interested in the problems arising in general practice as well as in medical theory. These *Consilia* are in reality commentaries on the seven works included in the *Ars medicina* (5), later known as the *Articella*, a collection of medical treatises much used by MONDINO; and on a few other Greek and Arabic writings.

Very similar to these treatises is another work of his, a commentary on the *Canones universales* of MESUË THE YOUNGER (6), which neither VONDERLAGE nor other biographers have discussed (7). This commentary has frequently (8) been attributed to MONDINO FRIULI (9), who taught and practiced medicine in

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of which the cautious historian will accept," CHARLES SINGER, *Fasciculo di medicina* (I, 34, Florence 1925). This statement ignores MONDINO's own remarks in his *Anatomia*, and all manuscript evidence for the fact that he wrote many commentaries. Cf. also B. VONDERLAGE, *Consilien des Mondino dei Luzzi aus Bologna* (Dissertation, Leipzig 1922) a good work ignored by SINGER.

(5) A collection of medical writings emanating from Salerno containing: JOANNITIUS (ḤUNAIN IBN ISḤĀQ), *Isagoge ad Tegni Galeni;* PHILARETUS (or THEOPHILOS PROTOSPATHARIOS ?), *Liber de pulsibus;* THEOPHILOS PROTOSPATHARIOS, *De urinarum;* HIPPOCRATES, *Aphorismi cum commentario Galeni;* HIPPOCRATES, *Liber prognosticorum cum commentario.* HIPPOCRATES, *Liber de regimine acutorum cum commentario Galeni;* GALEN, *Microtechni cum commentario Haly* ('ALI IBN 'ABBĀS).

(6) Known to Latin writers as JOHANNES SON OF MESUË, a physician of the eleventh century, whose pharmaceutical works were highly valued in the west. Cf. L. CHOULANT, *Handbuch der Bücherkunde für die ältere Medicin* (351, Leipzig, 1841).

(7) The only references to it which I have been able to find in secondary sources are those in three brief lists of his works; P. A. ORLANDI, *Notizie degli scrittori bolognesi* (121, Bologna 1714). G. FANTUZZI, *Notizie degli scrittori bolognesi* (VI, 44-46, Bologna 1788), and L. CASTALDI, Opere di MONDINO, in *Rivista di storia delle scienze* (XIV, 6, Siena 1932).

(8) The sole basis for the assumption that this commentary was written by MONDINO FRIULI is the statement of MAZZUCHELLI, who merely says, " Textus Mesue noviter emendatus, Petri Apponi—additio, Venice 1505. Una impressione anteriore insieme colla sposizione del MUNDINO, e d'altri autori fu fatta in Venezia nel 1495." G. MAZZUCHELLI, *Scrittori d'Italia* (I, part 1, 9, Brescia 1753).

(9) This one has very carelessly been made into two characters, one of Friuli and one of Cividale, by C. SINGER (*op. cit.* 34) although Cividale is in reality a village in the territory of Friuli, of the patriarchate of Aquileia, from whence this *one* Mondino came. Cf. also the *incipit* of the *Synonima*, " Mundinus de

Padua during the first half of the fourteenth century. But this MONDINO came from Cividale del Friuli according to the *incipit* of his *Synonima*, thus there is no reason to suppose that he was, like MONDINO DE' LUZZI, also called MONDINO DE LEUTIIS, DE LENTIIS, or by other variants of the name LUZZI (10). That this commentary was written by MONDINO DE' LUZZI is still more evident when it is compared with his other *Consilia*, and with his *Anatomia*.

In the introduction to his commentary (11), MONDINO discusses the nature of MESUË's treatise, its main divisions, and the genealogy of the author. As he says, this is a practical manual for the use of the ordinary physician, and not a theoretical treatise on medicine. But in his commentary, MONDINO himself, like his master TADDEO, cannot refrain from discoursing at some length on several metaphysical questions connected with medicine. Like the medieval doctor that he was, he starts the discussion with definitions of medical terms, " medicina est additio et subtractio scilicet a corpore humano—"; " De illis est ipsa ars medicine quae est de conservatione et introductione rerum—," and elaborates upon them in a most scholastic fashion. Neither does he fail to stress the celestial virtues of medicines, nor to expatiate at great length on the " complexions " of drugs, and the origins of these complexions.

His best and longest notes are those which deal with various drugs (de medicinis solutivis simplicibus) explaining their virtues, how they are prepared for use, and the " administratio ipsarum ad corpus." He even goes so far as to explain the best ways of planting and cultivating certain important herbs. And of course he gives a large number of prescriptions. In several notes he mentions apothecaries, and their methods of buying and preparing certain drugs, probably reminiscent of his own apprenticeship in his father's shop.

The citations in this commentary show that its author was

Forojulii civitate diocesis Aquilengensis," *Bibl. naz. di Torino, Codice* I, III, 35, f. 1 A.

(10) These same variants, de Lentiis, and de Leutiis, also appear in the titles of certain *Consilia* ascribed to MONDINO DE' LUZZI by VONDERLAGE, as well as in all of the titles of the commentary on MESUË.

(11) Printed in Lyons 1525, Venice 1490, Venice 1638, Venice 1570, and in other editions of MESUË's works.

a man who was exceptionally well-read in the classics of ancient medicine. His principal source is the *De simplicibus* of GALEN, but he also frequently cites other works by the same author; such as, *De sectis*, *De complexionibus*, *De therapeutice*, *De accidenti et morbo*, *De causis pulsibus*, *De virtutibus naturalibus*, and the *De regimine sanitatis*. It is interesting to note in connection with the fact that GALEN is the main authority in this treatise, that he is also the one most frequently cited in the *Anatomia*. But of still greater importance, is the evidence that there are several commentaries on most of these works by MONDINO DE' LUZZI; for instance, on the *De accidenti et morbo*, *De complexionibus*, *De virtutibus naturalibus*, and the *De causis pulsibus*, the latter also being mentioned in the *Anatomia*. Other authorities frequently referred to are; HIPPOCRATES, 'ALĪ IBN 'ABBĀS, PLATO, ARISTOTLE, IBN SĪNĀ, IBN RUSHD, ḤUNAIN IBN ISḤĀQ, AL-RĀZĪ, and other Arabic and Greek writers. The works which are his principal sources were also the favorite ones of TADDEO.

The only contemporary doctor cited is "*Magister*" TADDEO. In this case MONDINO is not citing the work of an authority, but is describing in detail an experience that the "master" had when he was summoned to a consultation of doctors at the bedside of the count of Arezzo. The very personal way in which this rather amusing story is told, coupled with the fact that the title "*Magister*" is never omitted before TADDEO's name, is strong evidence for the claim that MONDINO DE' LUZZI was the author of the commentary.

The most important points of similarity between this commentary and the *Anatomia*, however, are certain anatomical descriptions in both, which were more than likely written by the same hand. In the two works appear the same descriptions of the muscles of the walls of the stomach, a differential diagnosis between renal and intestinal colic, and several other anatomical descriptions which were unusual in the first half of the fourteenth century.

Harvard Library 189,
Cambridge, Mass.

MARY CATHERINE WELBORN.

The *Summa in VIII Libros Physicorum* of Grosseteste

Since the publication of Dr. LUDWIG BAUR's very informative and usually quite reliable critical edition of selected works of ROBERT GROSSETESTE, Bishop of Lincoln (1235-1253), it has been generally accepted that the *Summa in VIII Libros Physicorum Aristotelis*, often printed under his name (1498, 1500, 1504, 1506, 1515, 1538, 1551, 1583, 1586) cannot claim to be an authentic work of the great bishop. (1) BAUR examined the rather confused data collected by BOSTON OF BURY, LELAND, BALE, GESNER, TANNER, OUDIN and PEGGE, and showed that, although there was general agreement among the bibliographers to the effect that GROSSETESTE had written some sort of commentary on the Physics, OUDIN and TANNER had cited MSS which presented a text quite different from the printed edition which begins : *In primo libro Physicorum cuius subiectum est corpus mobile simpliciter...* OUDIN and TANNER had given the incipit : *Cum scire et intelligere adquirantur...* which is the beginning of the text of the Physics. The problem immediately presents itself : which of these commentaries did GROSSETESTE write ?

BAUR cites for the *Commentarius* which OUDIN and TANNER had mentioned the following MSS : Bodley, Digby 220, ff. 84A-105A, written in the early XVth century, and ascribed to GROSSETESTE in the original hand; Merton Coll. 295, ff. 120A-145A, written in the early XIVth century and ascribed to GROSSETESTE in a second but contemporary hand; Venice, S. Marco, Cl. VI,

(1) *Die Philosophischen Werke d. Robert Grosseteste, Bischofs v. Lincoln*, Münster i. W., 1912. (Vol. IX of the Baeumker *Beiträge* series), pp. 19-24. Cf. B. GEYER, *Die Patristische u. Scholastische Philosophie* (Berlin, 1928), p. 371. Cf. also a review by F. M. POWICKE of the present writer's edition of WYCLIF's *De Ente* (Oxford, 1930), in *Journal of Philosophical Studies*, (Oct. 1930), p. 645. SARTON : *Introduction* (vol. 2, 960).

222, (2) ff. 2A-30D, written in the middle of the XIVth century, and ascribed in a late XVth century hand. (3) The two Oxford MSS are of English provenance, and the Venice copy is the work of an Italian scribe.

He cites the following MSS of the printed *Summa:* Peterhouse, Cambridge, 188, ff. 119*b*-127*b*, dated 1458 and ascribed; Berlin, lat. 975, ff. 163 ff., dated 1426 and ascribed by a second but contemporary hand; Munich, Clm. 402, ff. 104-110*b*, dated 1458 and unascribed; Tours, 704, ff. 68*a*-86, written in 1426 in Valencia.

In presenting his solution of the problem of the authenticity of these works BAUR argued that the *Commentarius* was genuine because *(a)* the older MSS ascribe the work to GROSSETESTE, and *(b)* the last paragraph of the work appears as a separate opusculum under the title *De Finitate Motus et Temporis* in several GROSSETESTE collections. The *Summa*, on the other hand, he regarded as spurious because *(c)* it was extant only in MSS not earlier than the XVth century, and *(d)* even a cursory examination would show that the printed *Summa* differs considerably from known genuine works of GROSSETESTE 'in Sprache und Terminologie,' and clearly reflects the thought of a later period than GROSSETESTE's.

The arguments of BAUR appear to be well worked out and therefore merit consideration *seriatim*. Both *(a)* and *(b)* must be accepted as sound. The Merton MS is by itself almost determinative by reason of its age, its Oxford provenance and early associations. (4) To the MSS containing the opusculum *De Finitate Motus et Temporis* listed by BAUR we are able to add the following: Florence, Bibl. Marucelliana, C. 163, f. 15A-D (written *ca.* 1400 by an Italian scribe and ascribed to GROSSETESTE) (5), Modena, Bibl. Estense, lat. 396, f. 24A-D (written *ca.* 1500 by an Italian scribe and ascribed to GROSSETESTE); Prague, Nat. Museum, XII. E. 5, ff. 43D-44A (written middle of

(2) BAUR gives the erroneous signature Cl. XII, cod. lat. 41.

(3) BAUR gives also Turin, Bibl. reg. 951. This codex, of which the present signature is E.IV.10, contains, ff. 1A-31C, an early copy, *circa* 1300, of GROSSETESTE's *Commentarius in Libros Posteriorum*, but not the *Commentarius in Physica*.

(4) Cf. POWICKE, F. M., *Medieval Books of Merton College* (Oxford, 1931), p. 179 f.

(5) For other important items in this codex see S. H. THOMSON, 'The Text of Grosseteste's *De Cometis*' in *Isis*, XIX (1933), p. 20 f.

XIVth century by a Bohemian scribe and ascribed to GROSSETESTE). (6) This MS evidence, added to a general correspondence in tone and thought with his other authentic works touching the same subject places his authorship beyond any doubt.

But BAUR's arguments against the genuineness of the printed *Summa* are based upon insufficient evidence and a serious misunderstanding of the nature of the work. The *Summa* must be regarded as a genuine work of GROSSETESTE. It is quite true that the four MSS which BAUR cites are of the XVth century. But it is submitted that an argument based on the apparent absence of MS copies of a given work does not of itself carry greater weight than specific and repeated attributions in such late copies as do exist. If we were to regard as genuine only those works of which the earliest copies extant were contemporary or subcontemporary with the author's lifetime, the number of authentic medieval classics would be vastly and unjustifiably reduced. MSS do disappear, and many have; extant MSS are, many of them, incorrectly or not at all catalogued. Furthermore the absence of thirteenth century copies has not deterred BAUR from accepting the authenticity of two works, the *De Generacione Stellarum* and the *De Calore Solis*, for both of which he had but one MS, Venice, S. Marco, VI. 163, which he judged to be of the early XVth century. (7) It is hardly too much to say that a specific ascription in an unique XVth century copy of the work of a XIIIth author, is, if the internal evidence permits it, almost determinative. In the present case the late ascriptions receive additional weight by reason of the fact that an Italian, German or Bohemian scribe made the specific ascription to an English author. There could be no reason for him to falsify an ascription. The motivation would be difficult to understand in the case of a mere *Summa* of ARISTOTLE's Physics. We can only conclude that these scribes were copying from earlier copies which were unmistakeably ascribed to GROSSETESTE. We have also to consider the unanimity of ascription among the copies coupled with their widely different provenance. We have a MS

(6) Cf. BARTOŠ, F. M., *Soupis Rukopisů Narodního Musea* (Prague, 1928), s.n.
(7) Cf. THOMSON, *ubi supra*. The MS belongs, however, to the end of the XIVth century.

written in Spain in 1426 (the Tours MS), another written in Germany in the same year (the Berlin copy), another written in England in 1450 (the Peterhouse MS), and another German MS written in 1458 (the Munich Clm 402 cited by BAUR). But we have other copies which had escaped BAUR's vigilance : Munich Clm 8950, ff. 278*a*-290*b* (written in 1420 by a South German scribe and ascribed to GROSSETESTE); Munich Clm 26889, ff. 21*a*-30*b* (written *ca.* 1400 by a German scribe, and entitled *Octo Libri Phisicorum sub brevi compendio*, with no mention of GROSSETESTE or any author); Rome, Bibl. Angelica 127, ff. 7*a*-19*a* (written in 1470 by an Italian scribe and ascribed to GROSSETESTE) (8); Trinity College, Cambridge, O.2.11, ff. 1*a*-16*b* (written about the first quarter of the XIVth century by an English scribe. The copy is slightly *mutilus in initio :* the first folium has been cut out, and it is impossible to tell whether it was originally ascribed or not. The colophon bears no ascription).

We have then eight copies, instead of the four available to BAUR, of which six bear ascriptions to *Linconiensis*, and of which the oldest, an English MS, may have originally borne an ascription. Such unanimity is rare, and is fortified by the diversity of provenance. It is far too insistent to be set aside as false. To BAUR's argument *(c)* we reply by pointing out that as to age, our *Summa* is as well attested as the undoubtedly authentic *Commentarius*. For both works the oldest known copies are of the first quarter of the XIVth century and of English provenance.

But BAUR makes the further assertion *(d)* that the composition of the *Summa* belongs to a later date because of the tone and content. We have pointed out that on paleographical evidence the argument loses its force, but BAUR makes the categorical statement that the *Summa* ' in Sprache und Terminologie von den übrigen Grossetesteschriften erheblich abweicht.' (9) The

(8) The beginning of this copy has misled bibliographers, including BAUR, into thinking that it is a copy of the *Commentarius*. It begins : *Quoniam scire et intelligere contingit circa omnes...*, the usual text of the Physics, and the usual beginning of GROSSETESTE's *Commentarius*. But a paragraph further on we find : *In isto libro cuius subiectum est corpus mobile similiter...* the usual beginning of the *Summa*. The scribe essayed the role of redactor as well. The text is edited throughout, but there is no doubt that the basis of it is the *Summa*.

(9) It may be remarked parenthetically that GROSSETESTE's "*Sprache und Terminologie*" defy classification. The range of his writing, from comets, rainbows

printed *Summa*, if read as a commentary, does surprise by a restrained and obviously conscious terseness. But it is not a commentary at all. It is an abstract of the Physics, and a rather fine one. ARISTOTLE is occasionally mentioned in the third person, and, very rarely, AVERROES, under his usual title *Commentator*, but there is no comparison of nor appeal to authorities or divergent opinions. Nowhere does he take issue with ARISTOTLE as he does, e.g., in the *Commentarius* regarding the eternity of time and movement. Nor does he express approval or add to the arguments of the Philosopher. His purpose must have been to give students a handy manual of the voluminous and hardly obtainable complete work of ARISTOTLE. He did something of the same in the case of the Ethics. His *Tituli Librorum Ethicorum* is extant in many MSS and was published intercalated in the Commentary of AVERROES at Venice in 1483. (10) The procedure was very similar in the two cases, save that in the case of the Ethics, GROSSETESTE was dealing with a work much less familiar, and probably never before summarized in the West, because but recently translated by himself and his *adiutores*. His object therefore would be to make a more mechanical abstract of the contents of a little known work. Smoothness of style or a finished summary was not a principal *desideratum*. The Physics, on the other hand, had been known for approximately half a century, and he could take for granted a certain familiarity with its subject matter on the part of the students. A specimen passage from each of these works will show both their similarity and the difference just alluded to.

Ethics : Primum capitulum de eo quod est aliquis finis perfectissimus omnium bonorum operabilium in quem ceteri reducuntur quem oportet maxime intendere et querere, qui eciam est optima disciplinarum et primum bonum hominis quem melius est dirigere in pluribus quam in uno.

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and tides, table and court etiquette, to a Greek grammar, sermons and several compendious treatises on philosophy, to say nothing of French poetry and an extensive correspondence, would make almost any man's style difficult to categorize.

(10) Cf. PELZER, A., " Les Versions Latines des Ouvrages de Morale..." in *Revue Néo-Scolastique*, XXIII (1921), pp. 336-338; POWICKE, F. M., *Robert Grosseteste and the Nichomachean Ethics* (Proceedings of British Academy, vol. XVI), 1930, p. 4.

.....

14m capitulum in quo ostendit quod proximo dicta de causa felicitatis et eius diffinicione consona sunt dictis in principio libri, et quod irracionabilia neque pueri possunt esse felices et quod nullus potest dici ante mortem felix secundum Solonem : ex quo ortas quasdam dubitaciones de quando et quibus beatificandus est. Hoc solvens adnectit quod operaciones secundum virtutem sunt divine felicitatis et vite et permanencie. Et ideo felix semper operabitur secundum virtutem et fortunas feret optime et ideo nullus beatorum fiet miser cum existentibus semper optima operetur et sic est beatus vivens cui existent et existent usque in finem vite secundum virtutem et operaciones.

Summa : In primo libro Physicorum cuius subiectum est corpus mobile simpliciter non contractum, determinat Philosophus de principiis corporis mobilis ipsum constituentibus. Et sunt principia nature sive corporis mobilis tria, scilicet materia, forma et privacio. Materia est illud quod se habet ad formam, sicut aes ad statuam et lignum ad lectum, et universaliter sicut informe se habet ad formam antequam ipsam recipiat...

.....

In tercio libro Physicorum determinat Philosophus de motu et infinito. Et primo dat definicionem motus duplicem. Prima est hec : motus est actus entis in potencia secundum quod in potencia est, verbi gracia: rei alterabilis in quantum alterabilis est et non in quantum alteratur actu, est alteracio actus, et sic de aliis speciebus motus: hec definicio est formalis. Alia definicio est illa et est nobis manifestior cum sit materialis : motus est actus mobilis secundum quod mobile, verbi gracia: res, dum est in motu tunc dicitur esse motus et non quando est in motus termino ad quem, quia tunc cessat motus aquisito termino et sic de aliis speciebus motus.

It is quite evident that the subject-matter of the Ethics has not been so clearly thought out as that of the Physics; indeed we should not expect it from the person who has but recently translated the work from the Greek. ARISTOTLE is not so easily grasped as that. But it is equally clear that the method and in all probability the purpose is the same in both cases.

It must be further observed, with reference to the statement which BAUR adds to the one quoted above, that the *Summa* ' den Gedanken an eine spätere Abfassungszeit nahe legt ' that the

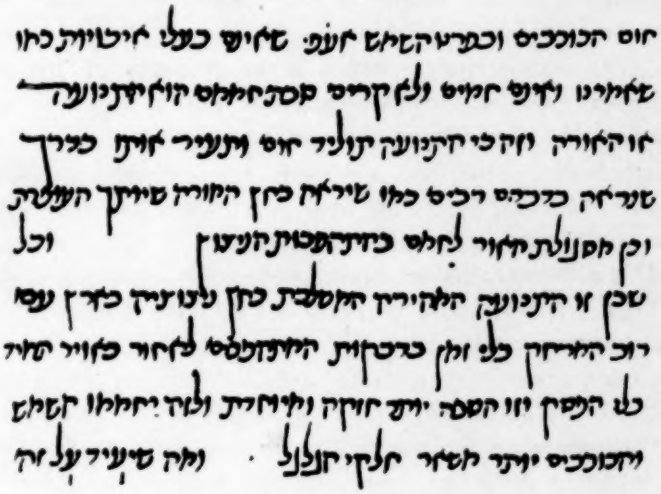
work purports to be an abridgement of a work of ARISTOTLE with as little interpretation as it was possible to add. Even on those points where GROSSETESTE was at sharp variance with ARISTOTLE, he scrupulously avoids taking any issue and endeavors simply to reproduce the Philosopher's thought. *Corrollarie arguit Philosophus quod est unum immobile primum...* is a statement with which, as we know from his other works, GROSSETESTE was not at all in agreement. The *Summa* is as pure Aristotelianism as any medieval abridgement could possibly be. To find in this closely reasoned abstract of the Physics doctrines proper to the fifteenth century may be a tribute to the perennial modernity of ARISTOTLE's thought, but it certainly indicates that BAUR had read very little of the *Summa*.

We must conclude that the *Summa*, as well as the *Commentarius*, is authentic, and point out that all of BAUR's objections to its authenticity cease to hold in the face of the existence of a MS a century older than any available to him and an examination of the text with regard to its purpose. The persistent and widely spread tradition of GROSSETESTE's authorship, which must, according to the accepted canons of MS transmission, inevitably have arisen from earlier MSS, compels acceptance of the authenticity of the *Summa*.

(Oxford.) S. HARRISON THOMSON.

A 13th century Theory of Heat as a Form of Motion

" The belief that heat was a substantial fluid had prevailed for many years and had proved useful; but there had always been a suspicion (extending back to the time of HOOKE (1) and NEWTON) that it might be a form of motion—either of the fine corpuscles of which ordinary matter is made up or of light corpuscles within matter." This statement represents the current view of the state of the theory of heat prior to RUMFORD's decisive experiments. FRANCIS BACON (2) some 84 years before the appearance of NEWTON's " Opticks " set down his conception of heat as a " motion expansive, restrained and acting in the strife upon the smallest particles of bodies. " (3) It will be of great interest that even two centuries earlier the following appears in the volume of a Jewish encyclopaedist.



(1) For quotations also from GASSENDI, HOBBES and LOCKE see G. BERTHOLD " Rumford und die Mechanische Wärmetheorie." Heidelberg, 1875.

(2) MÜLLER POUILLET, Lehrbuch der Physik, vol. II, ed. 1925.

(3) *Novum Organon*, II, 20.

As to " the heat of the stars and especially of the sun, although as we have said they have no inherent quality and are neither hot nor cold, the cause of their warmth is either the motion or the light for the reason that motion produces heat as is evident in many cases; for instance it is apparent in the case of the arrow that is sent forth and the lead of which melts [during its flight]. And thus it is with the heat-giving property of the light when its rays are reflected. So much the more this swift motion that sends its rays to the earth like an arrow traveling the enormous distance in no time with attachments that are reflected back continually and uninterruptedly through the air [produces heat] and this cause is stronger and more specific and therefore the sun and stars give heat more than other portions of the firmament."

He continues in more naive fashion. The paragraph shows that the author LEVI BEN ABRAHAM (1246-1315), a Jewish philosopher of Languedoc, although he did not fully understand the phenomenon, overlooking the effect of the friction of the air in heating the arrow, yet distinctly appreciated that heat is a form of motion. The volume in which the passage occurs is the third volume of an encyclopaedic work, " Liwyat Hen," and was written separately under the title " Sefer Hatekunah " [1276] (see SARTON " *Introduction to the History of Science*," vol. 2, 885). The manuscript (4) which is the property of the Jewish Theological Seminary of America was put at my disposal by my father who also revised the translation.

(New York.) ROSE S. MARX.

(4) This manuscript contains chapters 12-28. The passage cited occurs in chapter 12.

The five great naturalists of the sixteenth century: Belon, Rondelet, Salviani, Gesner and Aldrovandi: a chapter in the history of Ichthyology

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INTRODUCTION

Within the short space of 15 years in the first quarter of the 1500's, there were born five men who were destined to revolutionize the study of natural history in southwestern Europe, and to lay broad and deep and solid the foundations of ichthyology. These five men were, in the order of birth: GUILLAUME RONDELET (French), born 1507—died 1566; HIPPOLYTO SALVIANI (Italian), 1514-1572; CONRAD GESNER (German-Swiss), 1516-1565; PIERRE BELON (French), 1517-1564; and ULYSSIS ALDROVANDI (Italian), 1522-1605 or 07. Western Europe simply " broke out " with outstanding scientific men and with many of lesser capacity and reputation. They were the product of the Renaissance, that great complex of forces and efforts which made the world over.

The renaissance

That time of intense mental ferment called the Renaissance had its precursor in the " Revival of Learning " due to the resurrection of Greek and Roman art and literature and the development of Humanism (by Dante, Petrarch and Boccaccio, among others) following the Dark and Middle Ages. The Renaissance, however, from the scientific point of view had its roots in wider and deeper causes.

Set out in approximate order they are something like the following. The fall of Constantinople in 1453 was the final cause of the driving westward of the last-remaining Greek scholars with their precious manuscripts—from our standpoint, those of Aristotle and Theophrastus especially. Theodore Gaza had already fled from Thessalonica in 1430. In 1447 he was made professor of Greek at the university of Ferrara. From 1450-1455, he was in Rome busy translating Aristotle, Theophrastus, and other Greek authors into Latin, under the patronage of Pope Nicholas V.

About 1440, the process of paper-making became further perfected, and the printing press was developed to a practicality. In 1469 the first edition of Pliny's " Historia Naturalis " came from the press of J. Spira at Venice, and was thus made available for the use of scholars everywhere. Gaza's Latin version of Aristotle's " De Animalibus Libri x, De Partibus Animalium Libri iv, De Generatione Animalium Libri v," appeared at Venice in 1476. While in 1492 in the same city Aristotle's " Historia Animalium, Latine, Th. Gaza Interprete " came off the press. These issues were quickly followed by other Latin editions, and by editions of the " Opera " of the Stagirite in Latin.

How common the natural histories of Pliny and Aristotle became in the closing days of the 1400's may be realized when the facts are set out as to the number of editions of parts or of the whole works that were issued before 1500. No especial study has been made of Aristotle but I have been able to list no fewer than 11 editions. Careful search would probably bring others to light. Such search I have made (1) for Pliny, and it was

(1) Gudger, E. W. Pliny's Historia Naturalis : the Most Popular Natural History ever Published. *Isis*, 1924, 6, 269-281.

found that between 1469 and 1499, inclusive, a total of 39 editions (38 in folio and one in quarto) were issued. The influence of these widely diffused works must have played a great part in arousing interest in natural history studies.

Among other great factors in the mental awakening of these times were the developing of the mariner's compass and other instruments of navigation. These led to the making of longer voyages. Thus DIAZ first saw and doubled the Cape of Good Hope in 1488, and ten years later VASCO DA GAMA not only doubled the Cape but circumnavigated Africa, explored the Indian Ocean, and voyaged to India (1498). In the meantime COLUMBUS, the " Admiral of the Ocean," sailing west for India across the unknown Atlantic, discovered the New World. Shortly thereafter BALBOA from " a peak in Darien " in 1513 discovered the Pacific Ocean, CORTEZ overran Mexico 1519-1521, and PIZARRO conquered Peru 1531-1535. These voyages, discoveries and conquests had a tremendous influence in stimulating the minds and imaginations of the peoples of southwest Europe.

Then it must not be forgotten that MARTIN LUTHER in 1520 burned the papal decrees and started the Reformation. The spread of this great movement tended to free the minds of men from the domination of ecclesiastical absolutism which had long largely controlled all thinking.

Any one of these factors is a great one; all together they were tremendous. The minds of men woke up after a hibernation of nearly a thousand years. The printing press scattered far and wide the old and new knowledge of men and animals and plants, of voyages and discoveries, of freedom of religious thought, of new ideas of the whole world of men and things. Men grew " heady " under the influence of this great wealth of new things and far-reaching knowledge and thought. Never in the history of the world has there been a period of such intense mental stimulus and activity as that attending the culmination of the Renaissance 1450-1500, and during the century immediately following.

Under the tremendous stimulus of these influences, men were incited to study natural history with an enthusiasm and passionate fervor never known before and perhaps never excelled in our own times. The five men named—BELON, RONDELET, SALVIANI, GESNER, and ALDROVANDI—carried along by the great stimulating

forces of the day, revived the study of natural history dormant since PLINY's day (79 A.D.) and began the study of ichthyology as a distinct science. To trace their work, following the order of publication of their results, is the purpose of this study. And first it may be noted that BELON, RONDELET and SALVIANI form a triumvirate of investigators who worked chiefly on the fishes themselves, while the encyclopedists, GESNER and ALDROVANDI, endeavored to bring together all the knowledge of past and present natural history—the fishes being merely a part. From this it may be gathered that ichthyology was the first branch of natural history to be developed.

Thus the foundations of ichthyology, the most difficult branch of natural history since the fishes are water-dwellers, were laid by these men working separately but publishing their works about the same time—BELON 1551-1555; RONDELET, 1554-1558; SALVIANI, 1554; GESNER, 1558; ALDROVANDI, 1613.

STAGES IN THE DEVELOPMENT OF ICHTHYOLOGY

Three stages may be traced in the development of the science of ichthyology. I.—The stage of recording scattered or detached observations. This was the period of ARISTOTLE who knew about 117 or 118 fishes (the count—a difficult one—varies), chiefly those of the Mediterranean region. He is the *first* to set out a multitude of natural history facts of the utmost value about fishes, their structures, habits, wanderings, when and where found, time of greatest abundance, etc. He wrote at first hand about many of these fishes, but for others he was forced to note that " it is said "—from which we must judge that his books brought together not only his own observations but also all that had been recorded by others. His names were mainly those given the fishes by the ancient fishermen, and in the absence of figures afford little help in determining genera and species.

PLINY's data are mainly those of ARISTOTLE worked over. He adds little to our knowledge. In fact, he distinguishes even fewer true fishes, about 95—of which number only about 30 were additions to ARISTOTLE's list.

For 1800 years after ARISTOTLE no work at all comparable

PIERRE BELON

GUILLAUME RONDELET

E. W. GUDGER.

Isis, XXII, pl. 3. HIPPOLYTO SALVIANI E. W. GUDGER.

CONRADUS GESNERUS Medicus & Philosophus
Tot scribis libros, tantumq; moreris in arte,
Vt sis vel Medicis Bibliotheca tuis.

Isis, XXII, pl. 4. CONRAD GESNER E. W. GUDGER.

Isis, XXII, pl. 5. ULISSE ALDROVANDI E. W. GUDGER.

to his was done. True, a few scattered observations were recorded more or less incidentally, but it was not until the middle of the sixteenth century, when the five men under consideration began to publish books, that the second stage was ushered in. These founders of ichthyology set out to give descriptions and figures of well-determined individual fishes. They prepared the way for WILLOUGHBY and RAY who about 1685 laid the foundations of a scientific classification of fishes. This was further perfected by ARTEDI and LINNAEUS about 1750, when they clearly designated genera and species. Thus the third era was definitely ushered in.

It must be stated just here that our three outstanding early students of Mediterranean fishes, now to be considered, had certain forerunners who in a small way prepared the way for them. PIERRE GILLES published at Lyons in 1533 and 1535 a little book: "De Nominibus Gallicis et Latinis Piscium Massiliensium." This contains the common names only, ancient and contemporary, of 93 Mediterranean fishes. I have seen this book, but where I cannot recall. There is no copy in New York. Furthermore, PAULO GIOVIO published in 1554 "De Romanis Piscibus." This work passed through a number of editions at Rome and elsewhere. In the original edition (copy in A. M. N. H.) he describes under local names about 42 true fishes. Without figures these descriptions are practically useless.

These men and their books had little effect on the work of their contemporaries now to be considered, and are practically unknown to modern ichthyologists. Not so, however, the three great students and writers whom we will now consider.

THE TRIUMVIRATE
BELON, RONDELET, SALVIANI

These three men worked chiefly on the fishes themselves, paying comparatively little attention to the writings of the classical authors, but as will be shown that little in a slowly but steadily rising volume. However, as will be seen later, they may thus be set apart definitely from GESNER and ALDROVANDI, the encyclopedists.

Pierre Belon
1517-1564

This scientist was born near the town of Le Mans (Sarthe), and at the early age of 47 was murdered by an assassin in the Bois de Boulogne near Paris. In his 47 years he did a great amount of original work and surely would have done more but for his untimely death. He studied medicine in Paris and took the doctor's degree. That he ever practiced his art, I can not surely affirm. Later he studied botany under Valerius Cordus. Possibly his major interests were in plants, on which he published several works. The Cardinal de Tournon became his patron and sent him on an extensive scientific journey in Italy (where at Rome he met Rondelet and Salviani) and in the countries around the eastern end of the Mediterranean Sea. He wrote several works descriptive of his observations on these journeys. He was a naturalist in the broad sense, and possibly his chief work is his "L'Histoire de la Nature des Oyseaux," Paris, 1555, 381 p., sm. fo. In this work on birds, said to be the best of its kind produced in the sixteenth century, he has two facing figures of the skeletons of bird and man, with homologous bones similarly labelled—the first figures of the kind ever published. By reason of these figures he is often called the founder of comparative anatomy. However, we are most interested in his work on fishes. His first published book was :

L'histoire naturelle des estranges poissons marins,
avec la vraie peincture & description du Daulphin,
& de plusieurs autres de son espece.
Observee par Pierre Belon du Mans.
A Paris. 1551

This is the first printed book devoted to fishes and having such a title page. But to the early naturalists any water-dwelling animal was considered as a fish or was to be classed among them. Thus of the 55 leaves in this little book, about 38 are given to the dolphin and its kind, about 5 to the hippopotamus, and two or three to the nautilus. However, ten fishes are briefly described with clearly recognizable figures. Three of these fishes, two

sturgeons and the tunny, were introduced to show that they are *not* dolphins. These are the first published figures of fishes known to me. However, this book deals primarily with the dolphin, its structure and reproduction—the latter being compared with that of terrestrial mammals.

Two years later (1553) BELON published his second book :

De aquatilibus. Libri duo
Cum eiconibus ad vivam ipsorum effigiem,
Quoad eius fieri potuit, expressis.
Parisiis, 1553.

This is an enlargement of the preceding work and like it includes various water-dwellers with descriptions and recognizable figures. However, BELON describes about 110 species of fishes—16 from fresh water, the remainder, including 22 cartilaginous fishes, being marine (presumably all Mediterranean). He figures 103 of the 110 species. One of these figures shows a salmon with the hooked lower jaw characteristic of the adult male salmon (the first known figure of this peculiarity). However, since BELON labels the figure " Caput Salmonis fœminæ," he evidently did no dissection. But despite this and other defects, there is in this work by our old author, a real beginning of the science of ichthyology. This work was so popular that it appeared in ten other editions and versions, the last in 1620.

In 1555 appeared the French translation of the preceding Latin work, and another edition was issued in 1560. These little books by BELON are much prized. The title of the original French edition is :

La nature et diversité des poissons
avec leurs pourtraicts representez
au plus pres du naturel.
Paris, 1555.

This work constitutes the basis for the allegation that BELON was the founder of ichthyology, and in either the Latin original or the French version the allegation may be fairly granted. Certain it is that he blazed the way and ushered in a new epoch in the study of fishes. He was a real researcher in the hitherto unexplored

field of ichthyology. However, his work as an ichthyologist was overshadowed by that of the man next to be considered.

The portrait of BELON given herein is a photographic copy of that found in the last of his works quoted. In the copy in the library of the American Museum, the portrait has been colored by hand, but the photographic reproduction compares favorably with an uncolored copy in a recent biographical sketch of BELON.

GUILLAUME RONDELET
1507-1566

Another Frenchman, and another one of the founders of ichthyology, is RONDELET. He was born and lived most of his life in the university town of Montpellier, only seven miles from and actually in sight of the Mediterranean.

Until his 18th year, RONDELET's health was very delicate. About this time he went to Paris and studied Latin, Greek, and philosophy. Later he took his medical degree at Montpellier, practiced his art in various places, but returned to his native city where he was physician to the Cardinal DE TOURNON, who became his patron as well as BELON's. In 1545 he was appointed Regius Professor of Medicine in the medical school, and in 1556 he was chosen Chancellor of the whole university, both of which positions he held till his death in 1566. His chief work in the university was in anatomy and his reputation attracted large numbers of students, some of whom attained eminence in various branches of science. He was esteemed one of the chief ornaments of the Montpellier school, and in testimony of this the authorities had placed on the front of the building housing the school of medicine, an inscription which in part reads as follows :

> Gul. Rondeletius Montispel. ingenii fœcunditate
> et Doctrinæ uberitate toto orbe Clariss.

As an outcome of his activities as teacher and practitioner, RONDELET published a number of medical works which went through several editions. Gathered and published as " Opera " they appeared in eight or ten separate editions and reprintings.

Through the help and often in the entourage of his patron, the Cardinal DE TOURNON, RONDELET travelled extensively through France, to Amsterdam, and through northern Italy, studying fishes everywhere. His long residence in sight of the Mediterranean together with the importance of its sea fisheries in his day, probably influenced him to study fishes, and fishes formed the subjects of his two chief works. The first is :

Libri de Piscibus Marinis, in quibus
veræ Piscium effigies expressæ sunt.
Lugduni [Gallorum], 1554.

The first four books have to do with morphology and internal anatomy of fishes. In the remaining books are described all the fishes (244) known to RONDELET. The title says marine fishes, but there are 47 fresh water fishes described, and 197 marine ones—mainly from the Mediterranean. This folio of 583 pages is well indexed and for the time well illustrated, the figures being better than those in BELON's works. It is dedicated in eloquent terms to the Cardinal DE TOURNON.

In 1555, RONDELET published what is generally reckoned as Vol. II of the preceding. It is commonly bound up with the other, but it has its own title page and pagination. It is :

Universæ aquatilium Historiæ pars altera,
cum veris ipsorum Imaginibus.
Lugduni [Gallorum], 1555.

It is made up of seven " Libri," three of which are devoted to fresh water fishes. A few marine fishes are, however, scattered through the other books, and various water-dwellers of other kinds (chiefly " Testacea ") are found among the fishes. About 60 fresh water fishes are described and about 50 are figured. Some of his fishes are estuarine and are difficult to place, hence the " about." One figure and description are of a pug-headed carp—the first record of this deformity.

These two works in Latin were translated into French and published in somewhat abbreviated form in quarto under the title :

La première [et la seconde] partie
L'histoire entière des poissons
Lion [Lyons], 1558

RONDELET's work is an advance on BELON's. His descriptions are fuller in detail, with notes on habits and natural history, the figures (wood cuts) are highly praised by CUVIER, the names are given in various languages (Latin, Greek, French, and often Italian and Spanish), and a definite effort is made to bring together related forms in broad groups. RONDELET's work undoubtedly served as a basis for that of WILLOUGHBY and RAY, and later of ARTEDI and LINNAEUS. Furthermore, CUVIER states that this was the outstanding work on Mediterranean fishes until that of RISSO in 1810.

The portrait given of RONDELET is that found at the front of all his works. I have seen others, but this one is of course contemporary and beyond doubt authentic.

In 1558, FRANCIS BOUSSUET published at Lugduni Gallorum (Lyons) two poems bearing the general title "De natura de piscibus marinis scripsit historiam." RONDELET's figures were used and each has beneath it a short Latin verse in epigrammatic form describing the fish. The two works are generally bound together, but each has its own title page and separate pagination. Together they form a pictorial history of fishes based on RONDELET's books.

HIPPOLYTO SALVIANI
1514-1572

This student of Mediterranean fishes was born near Urbino in the year indicated. Having received such education as was available in his day, he studied medicine and for the remainder of his life acceptably practiced his art in Rome and taught medicine in its university. As a physician and student of natural history he attracted the attention of Cardinal CERVINI and afterwards became physician to three popes. SALVIANI evidently had the lively scientific interests of the time, for it is said that every new natural history object brought to Rome was referred to him. These he states that he displayed to and discussed with his friends

that " we might be able to arrive at correct conclusions." His interests, however, were mainly fishes. Apart from his few medical writings, which do not concern us, his opus is :

Aquatilium Animalium Historiæ
Liber Primus, cum Eorundem
Formis, Aere Excusis.
Romæ, MDLIIII.

This is a folio of 256 leaves, which was issued in parts (but not so numbered—" Liber Primus " in the title only) from 1554 to 1558, in January of which year the last signature was published. The printing was done in the house of the author as we read on leaf 256. The plates were printed from engravings on brass or copper—" aere excusis "—done presumably in SALVIANI's house and undoubtedly under his eye. There are 81 full-sized plates, of which one portrays an octopus and three show squids, leaving 77 plates devoted to fishes. Now the last of the plates is marked P. 99 by SALVIANI and this is commonly reckoned as the number of plates when it is really the number of specimens figured. If the fish is large only one is engraved on a plate, on others there are two, three or four figured on what today would be called a plate; but our author labels each *figure* thus : P. 19, etc. There are then 93 fishes figured (one in two views but each numbered separately), 18 being considered new species by the authorities. These reproductions are far and away ahead of any of the old time figures, and indeed of many modern ones. The figures were drawn from the fishes themselves, chiefly Italian and certainly Mediterranean species.

SALVIANI's text is divided into two parts. The first 55 leaves of his book are given over to tables setting forth in alphabetical order the Latin, Greek and common names; to the " Attributa "; to the references to each fish in ARISTOTLE, OPPIAN, PLINY, ATHENAEUS; and in the last (ninth) column to " Varii Auctores." The remainder of his book is given over to plates and descriptive text of fishes only (including the octopus and two squids) arranged in no system whatever.

The plates have been accounted for. The text is divided into 92 chapters—each designated as a " Historia." Three Historiæ

are devoted to the cephalopods, leaving 89 for the fishes proper. Just here it should be noted that SALVIANI recognizes the cephalopods as non-fishes. For these his general heading is "Quae Mollia [Mollusca?] Dicuntur." Apparently then there should be but 89 fishes described, but our author sometimes discusses more than one fish in a "Historia" and under MUGIL he notes eight "species." The plate numbers and the Historiæ do not agree, and it is difficult to reconcile them.

The "Historiæ" are generally divided into varying numbers of sections to make the data easier to find. SALVIANI sets out his own first-hand data and then critically discusses the accounts in the old authors listed. He is very scholarly in this, giving exact references in the margins. He is the last of the triumvirate referred to above, each author of which lists only the fishes he has seen and handled. But since SALVIANI also includes much data on these fishes from his predecessors, he is the connecting link with the encyclopedists—the first of whom is now to be considered.

The portrait of our Roman ichthyologist is a copy of that in the center of the engraved title page of his book. This work is said to have had several editions but great difficulty has been had in getting any definite data. I have discussed the matter as fully as the facts warrant in BASHFORD DEAN'S "Bibliography of Fishes," vol. III, p. 312.

THE ENCYCLOPEDISTS
GESNER AND ALDROVANDI

There are now to be considered the other two of our five early naturalists, who not only recorded all that they knew personally about fishes, but who brought into their great tomes the knowledge of their fellow workers and of all the writers of the past. They may be fittingly designated as the encyclopedists.

CONRAD GESNER
1516-1565

GESNER, a German-Swiss, was born at Zurich in 1516. From his early childhood he evinced that love of nature, which per-

severed in made him the greatest naturalist of his times. In his early life he was handicapped by poverty and ill health (indeed the latter burden continued through all his life), but he persevered, studying at various centers of learning (including a year—one authority says four—at Montpellier under RONDELET) until he became skilled in ancient languages as well as in medicine and natural history. He obtained his medical degree at Basle in 1540, and began shortly afterward as a medical practitioner in his native city. In 1554 the magistrates of Zurich appointed him city physician and public professor of philosophy and natural history. Seeking health and specimens, he travelled much throughout Switzerland, southern Germany, France, and northern Italy (where he met SALVIANI and ALDROVANDI). Having, as chief physician of Zurich, successfully fought the plague in 1554, he was personally attacked in December 1565, during the second pestilence. Recognizing that his end was near, he settled his affairs, and then had himself carried to his museum, where he quietly passed at the age of 49.

Despite the lifelong handicap of ill health, and the laborious duties of his profession, GESNER, by reason of great native ability and intense application, became the most learned man of his day in western Europe. We are not concerned here with his medical and literary works, while for accounts of his great " Bibliotheca Universalis," the interested reader must go elsewhere, and also for an account of the fate of the materials of his projected natural history of plants. In this brief sketch attention must be confined to his " Historia Animalium," written in Latin and appearing volume by volume at Zurich (Tiguri) from 1551 to 1587. These four great folio tomes comprise 4500 pages, illustrated by hundreds of wood cuts, and in them is brought together the knowledge of the world past and present of the animals then known. Before GESNER's there had been other encyclopedias; those of BARTHOLOMAEUS ANGLICUS (1470), of JOHANN VON CUBE (1480), of KONRAD OF MEGENBURG (1475), and of VINCENT DE BEAUVAIS (1483). These, however, had been largely inchoate, whereas that of GESNER, in part original, in large part compiled, was erudite and orderly. Well has he been called the " German Pliny "; indeed he was a polyhistor who sought to encompass all learning.

Of his great encyclopedia we are most interested in that part bearing the following title :

Historiæ Animalium Liber IIII
qui est de Piscium & Aquatilium
animantium natura.
Tiguri [Zurich], MDLVIII.

This great folio comprises 1297 pages and is illustrated by over 900 woodcuts. The fishes and other water animals are set out alphabetically according to their Latin names and nearly every one has an illustrative figure. The account of each animal is taken up under some seven or eight sub-heads in true encyclopedia fashion. GESNER has incorporated herein the work of BELON and RONDELET and has labelled each form with the name of its original describer. Data is also quoted from all other known authors who have described water animals. The figures are very good woodcuts, and all, original and copied, were drawn (so we are told) either by GESNER himself or under his eye by artists in his own home. These materials had been accumulated by an enormously wide reading (GESNER says that he consulted 250 works), and by an equally wide correspondence—said to have included every student of natural history in Europe.

This volume IIII—the " De Piscium & Aquatilium animantium natura "—was much edited, translated and republished as I have indicated on pages 249-250 of vol. III of DEAN's " Bibliography of Fishes," where fourteen versions and editions are recorded. The most definite of these versions is " Fischbuch," translated by CÜNRADT FORER and published in German at " Zürych," 1653.

I have been hard put to it to find a contemporary portrait of GESNER. None of his great folios in our library contains a portrait. That in Jardine's Naturalist's Library (a good copper plate) is without source. The one in W. A. LOCY's " Biology and its Makers " (New York, 1908, p. 114) is a copy of the above. However, Dr. J. H. BARNHART of the New York Botanical Garden located a portrait of GESNER in Acta Horti Bergiana (Meddel. K. Svenska Vetensk. Akad. Trägård), 1905, Bd. III, taf. 9. This is a zinc etching of a figure engraved by DE BRY. Then the question arises which DE BRY, THEODORE (the father) or JOHN

THEODORE (the son)? In endeavoring to answer this question, three of the expert assistants in the New York Public Library gave help which step by step led to the desired end. First they found records of numerous portraits, several credited to DE BRY and identical. Then they produced four portraits, of which three showed marked resemblance to the DE BRY portrait. The fourth by DIETRICH MEYER, dated 1602, was very unlike the others.

However, the clue that finally led to the solution is the monogram on the right of the DE BRY figure reproduced herein. This monogram led us to JEAN JACQUES BOISSARD, who at Frankfort a/M published in four parts and under varying titles a great thesaurus of the " effigies et vitae " of the illustrious men of the Renaissance. The first edition of " Pars IV " bears title (abbreviated) as follows : " Iconum Viros virtute atque Eruditione Illustris ræpresentantium... singulis Eiconibus. adjuncta distista... In aere recens scite facta & forus data per hæredes Theodori de Bry... Anno MDXCIX." No. XXIII of this is the portrait of GESNER reproduced herein. Now THEODORE DE BRY died in 1598 and his heirs were JOHN THEODORE and JOHN ISRAEL. The latter seems to have engraved few portraits while the former did many. In other parts of BOISSARD's work are engravings by both the THEODORES, portraits in styles so diverse that they cannot possibly be confused.

I have no doubt whatever that the portrait of GESNER reproduced herein was engraved by JOHN THEODORE DE BRY. Indeed a later edition of one of the parts (not IV, however) of BOISSARD's series, published in 1628, specifically states that the portraits therein were " Artificiosissime in aes incisæ Joan Theodor de Bry. "

So the mystery was solved and there is here given a portrait of GESNER published only 34 years after his death. However, Dr. BARNHART has discovered what may be a contemporary portrait. The Emperor FERDINAND granted armorial bearings to GESNER. These were engraved on a medallion and on the other side was GESNER's face in profile. In 1751-1753 C. C. SCHMIEDEL brought out " C. Gesneri... Opera Botanica " in two folio volumes at Nuremberg. At the beginning of volume I, SCHMIEDEL has an extensive biographical sketch of GESNER, and as a head piece there is a copper engraving including both sides

of the medallion. The portrait, however, is in side view, is too small to reproduce here, and cannot be enlarged.

Ulyssis Aldrovandi
1522 or 27—1605 or 07

This great encyclopedist was born at Bologna of a family said to be noble. He inherited a fortune, which along with the emoluments of his life work, he employed in assembling a museum in his native city and in gathering other materials for a natural history even greater than Gesner's. His education was carried on partly in Bologna, partly in Padua, and he was graduated Doctor of Physic by the university of his native city in 1553, and in the following year was appointed professor of philosophy and logic, and lecturer in botany. Eventually all these positions seem to have been combined and he was for the remainder of his life professor of natural history in the University of Bologna.

On a visit to Rome in 1550 he met Rondelet, also a visitor there, and Salviani—of whom he became a lifelong friend. There is reason to believe that he also knew Belon and Gesner. These contemporaries, especially Rondelet and Salviani, may have had some influence in turning his mind toward the fishes. Aldrovandi, himself, states that early in his career as a student he kept before his mind the ancient Greek saying that " Nothing is sweeter than to know all things." This led later to his formulating a plan for a gigantic encyclopedic natural history that would include his own first-hand data supplemented by all recorded knowledge of such subjects. For illustrations for this work he states that he employed one painter for thirty years and various other draftsmen and engravers who worked under his own eye. Along with these he speaks (also by name) of various able assistants who helped prepare, describe and care for the contents of his museum.

The " Opera " of Aldrovandi are comprised in 13 huge folio tomes issued at Bologna (Bononiæ) from 1599 to 1668. Only five or at most six were published prior to Aldrovandi's death in 1605 or 1607, the others were brought out later by various hands—students, successors and other friends. Each of these

separate works appeared in later editions, mainly at Bologna. All were published in a most sumptuous folio format, with thousands of illustrative woodcuts. The " Opera " of ALDROVANDI constitute the greatest collective natural history ever published. He was at work on it for 50 years, and the first volume did not appear until he was 77 years old and blind. He literally gave his life and his fortune to his ideal of what should constitute an encyclopedic natural history, and he is justly called the " modern Pliny," and " the most inquisitive man in the world [of his day] with regard to natural history." Much that he wrote is obsolete, yet " There is still a vast store of curious... and valuable information, and the naturalist who would know the opinions of the ancients and the origin of many ideas concerning his favorite science ... cannot refer to these volumes without finding much both of pleasure and profit."

As to the fate of his materials, it is stated on good authority that there are found in Bologna today 20 volumes of figures of animals in color, the originals from which the woodcut figures in ALDROVANDI's books were made. These were carried away to Paris in the Napoleonic wars but were returned in 1814. Preserved with them is a great mass of the manuscripts of the texts of the great folios of our author's encyclopedic work.

That one of the separate volumes now to claim our attention is :

DE PISCIBUS LIBRI V
ET DE CETIS LIB. UNUS
BONONIAE, 1613.

This was brought out after ALDROVANDI's death by JOANNES CORNELIUS UTERVERIUS and HIERONYMUS TAMBURINUS. The part dealing with fishes comprises 668 folio pages illustrated by hundreds of woodcuts, which are in the main cruder than those in BELON's work. A certain number of figures and descriptions are of new Mediterranean fishes, but the greater part of the book is a compilation—even more than is found in GESNER. This work is, however, an improvement on GESNER's book because it contains nothing but fishes; all other " water-animals " are relegated elsewhere. It is then the first work in the history

of the world devoted *solely* to fishes. As such, and being encyclopedic in nature—bringing together everything ever written on fishes in the past, it is a source book of great value. Indices of the Latin, Greek, Italian, French, and Spanish names of the fishes add to the usability of the book.

The " De Piscibus " passed through many editions. I have located ten published from 1613 to 1644. These editions attest its popularity and the esteem accorded it.

ALDROVANDI was probably not so able a man as some of the other naturalists studied, but he had health, means, academic position, enthusiasm, assiduity, long life, and the will to devote his whole life and fortune to the completion and publication of his great work. Furthermore, outside of his own fortune freely spent, he had the help of the authorities and of the treasury of his native city. Judged by the outcome, he well deserves the appellation " the modern Pliny. "

The library of the American Museum contains a set of first editions of ALDROVANDI's works. In only one of these—the third volume of the " Ornithologiae " (1603)—is there a portrait of our author. However, there is pasted on the back of the frontispiece-title-page of the " De Piscibus " a contemporary engraved portrait. Experiment shows that this is a mirror image of the portrait in the " Ornithologiae " III. The inscription in the oval " frame " around the portrait is, however, different from that in the " Ornithologia ". This latter with the surrounding scroll work, coat of arms, etc., is signed " I. Corn. Utervver. M. D. faciebat. " The portrait in the " Ornithologia " was printed lightly and has also faded, hence the portrait here included is the darker and sharper one from our " De Piscibus ". It is undoubtedly a contemporary portrait.

SUMMARY

In the lives and work of these five early naturalists, there stand out certain things, all of which can hardly be explained as coincidences.

1. — These five men were all born within a few years of each

other. RONDELET, in 1507; seven years later (1514) SALVIANI; two years later (1516), a total of nine from RONDELET, GESNER; one year later (1517), a total of ten years, BELON; five years later (1522), a total time space of 15 years, ALDROVANDI. This was coincidence.

2. — These men (ALDROVANDI excepted) died comparatively early and close together: BELON (1564) aged 47; GESNER one year later (1565) aged 49; another year later (1566), two in all, RONDELET, aged 59; six years later (1572), a total of ten, SALVIANI, aged 58; last of all, 33 years later (1605), ALDROVANDI passed at the age of about 83—the only one of the five to reach old age. This is also coincidence.

3. — The books on fishes which these men published all appeared close together. BELON's dates (as recorded above) are 1551, 1553, and 1555. RONDELET's works appeared in 1554, 1555, 1558. SALVIANI's folio was issued 1554, and GESNER's four years later, 1558. Only ALDROVANDI's book was widely set off, appearing posthumously in 1613. This can hardly have been coincidence.

4. — The works of these men form an ascending gradation. BELON's first book (the first ever published, devoted, according to its title, solely to fishes) is small and given over mainly to the dolphin. His second work (1553) approached a real ichthyology but included many other sea-dwellers. RONDELET's works are of a distinctly higher grade, but to him also the term fish included many other water-dwellers.

BELON, touched hardly at all on the ancient literature, and RONDELET very lightly. Both confined themselves almost wholly to the actual specimens. SALVIANI dealt almost solely with fishes, but went extensively into the writings of the classical writers on the particular fishes he studied. He was the connecting link between the non-literary searchers, BELON and RONDELET, on the one hand, and the encyclopedists, GESNER and ALDROVANDI, on the other.

GESNER's book *was* encyclopedic but most thoroughgoing and scientific. However, he unfortunately included large numbers of *aquatiles* among his *pisces*, and when the literature for these was brought forward and discussed, it swelled

his folio to 1297 pages. On the other hand, ALDROVANDI, while bringing in all the literature of *pisces*, confined his work to the fishes and brought it within the limits of 668 folio pages. In the strict sense of the word, his book is the first published ichthyology—the whales (" De Cetis ") being set off in a separate Liber but paged consecutively.

That the work of these five men forms an ascending gradation, can, I think, hardly be set down as a coincidence when one considers the opportunities that came to each. A fuller study of each man's life and work than that contained in the brief notes set out above, would, I believe, confirm this very effectually.

5. — These men were all trained in medicine and four practiced and taught the art. Here, as in a vast number of other men who might be named, medical training preceded scientific research work. This can hardly be called coincidence. The early scientists were nearly all doctors. And in my early boyhood in the isolated plateau of the southern Appalachians in western North Carolina almost the only man, except a certain hunter, who knew any natural history, was our doctor.

6. — The whole matter, it seems to me, may be summed up in the statement that these five early naturalists and founders of the science of ichthyology were the product of their times—the Renaissance.

New York City. E. W. GUDGER.

A Bibliography of Tracts and Treatises on the Comet of 1577

The history of cometary theory in general should be of great interest to students of the history of science. The observations of the comet of 1577 and the tracts and treatises dealing with it form a step in the transition from ancient to modern astronomy.

The comet of 1577 was the first of those which occasioned the writing of innumerable tracts and treatises. The large number of these is surprising. There are 111 separate items listed in the accompanying bibliography, and I should not be at all surprised to learn of another 20 of which I am at present ignorant. These works were printed in what are now the Czechoslovak Republic, England, France, Germany, Holland, Italy, Sweden and other countries, that is, almost all over Europe, and the languages represented are not only Latin, but also English, Flemish, French, German, Italian and so forth, making the works available to others as well as to the learned classes.

It is of importance to us to consider what caused this widespread interest in the comet of 1577. Printing had been known for more than a century and was an easy way in which to communicate one's observations once they had been made. But more than that, the brilliance of the comet and the long duration of its visibility to the naked eye (from November to January) had attracted the attention not only of the trained astronomers but also of the clergy who regarded it as an ill omen, the amateur star gazers, and the wealthy leisure class, all of whom set their thoughts in writing. The poorer peasants listened to sermons on the startling phenomenon.

The comet of 1577 is of astronomical and historical importance because of the valuable observations made of it. TYCHO BRAHE proved that it had no parallax and consequently could not be

an atmospheric phenomenon but must be farther away from the earth than the moon. He was supported in this argument by other astronomers, whom he mentions in his great book on the comet, such as CORNELIUS GEMMA and MICHAEL MAESTLIN. TYCHO BRAHE even attempted to calculate the comet's orbit, finding from his calculations that it was circular. The orbit of the comet of 1577 was the first of which a calculation was attempted. It has since been recalculated by WOLDSTEDT. It is not a closed orbit and the comet will not reappear.

The treatises represent several phases of thought characteristic of a transition period. On the one hand there are prayers to avert the ill effects of the comet, without any attemp. at scientific treatment. On the other hand there are scientific observations of surprising accuracy, considering the inadequacy of the instruments. (The telescope was not invented for another thirty years.) In between these two types of treatises there are some in the " Aristotelian tradition " which though on the wrong track, present their data in great detail and in a logical arrangement.

The purpose of presenting this bibliography, aside from its possible value as a bibliography, is to beg the assistance of the learned readers of *Isis* in locating copies of those works which I have been unable to consult and in supplying new titles, with perhaps the location of copies thereof, which, owing to my ignorance, I have been unable to include in this bibliography.

The bibliography deals only with treatises devoted specifically to the comet of 1577. Unless otherwise indicated, I have seen copies of all the books listed. Where I have been unable to do so, I have given the reference which makes me believe there is such a book. If I once had a reference to a given book, I did not seek further references to that same book, but I have sometimes included them if accidentally encountered. For the books which I have seen I have given the reference to the particular copy of the book which I examined. When I had already seen a copy of a book, I did not look for additional copies of the same book, although in the cases where I examined more than one copy, I have indicated those copies which I saw.

Some books I have considered unlocated, if the copies of which I have knowledge are in libraries not easily accessible to me. For example, I should find it quite difficult to examine a book

in the Pulkova Observatory and should therefore be very grateful for knowledge of a copy within my reach.

I have made no effort to find manuscripts dealing with the comet of 1577 but have included references to a few which came to my attention.

In each case I have tried to copy the title page exactly including quotations given on it, but I have italicised the important names. Also, when the printer or the date of publication or the place of publication does not appear on the title page, I have added it from another source, usually another part of the book, but always italicised.

I should be very grateful for any knowledge concerning books dealing particularly with the comet of 1577.

Abbreviations used in the following pages :

B.

Catalogue Des Ouvrages D'Astronomie Et De Météorologie Qui Se Trouvent Dans Les Principales Bibliothèques De La Belgique, Préparé et mis en ordre à l'Observatoire Royal de Bruxelles; Suivi D'Un Appendice Qui Comprend Tous Les Autres Ouvrages De La Bibliothèque De Cet Etablissement. Bruxelles, 1878.

Bib. Belg. Valerii Andreae

VALERIUS ANDREAS : *Bibliotheca Belgica...* Lovanii, 1623, and a later edition, 1643.

Bib. Belg. Gand

Bibliotheca Belgica. Bibliographie générale des Pays-Bas, par le bibliothécaire en chef et les conservateurs de la bibliothèque de l'université de Gand. Two series (I and II), 1880-1890 and 1891-1923. Gand, CAMILLE VYT.; La Haye, MART. NIJHOFF.

B.N.

Bibliothèque Nationale, in Paris.

B.M.

British Museum, in London.

C.D.H.

C. DORIS HELLMAN

C.U.L.

Columbia University Library, in New York City.

G.S.

Dr. GEORGE SARTON.

Houzeau

J. C. Houzeau, and A. Lancaster : *Bibliographie Générale De L'Astronomie...* Première Partie, Bruxelles, Juin, 1887.

H.C.L.

Harvard College Library, in Cambridge, Massachusetts.

N.Y.P.L.

New York Public Library, in New York City.

Poggendorff I

Biographisch-Literarisches Handwörterbuch zur Geschichte Der Exacten Wissenschaften... Gesammelt von J. C. Poggendorff, volume I, A-L, Leipzig, 1863.

White, I

Andrew Dickson White : *A History Of The Warfare Of Science With Theology In Christendom*, volume I, New York, 1913.

Carl

Dr. Ph. Carl : *Repertorium der Cometen-Astronomie*, Munich, 1864.

Struve, I

Otto Struve : *Librorum In Bibliotheca Speculae Pulcovensis Anno 1858 Exeunte Contentorum Catalogus Systematicus. Edendum Curavit Et Praefatus Est Otto Struve...* Petropoli, 1860.

Struve, II

Otto Struve : *Librorum In Bibliotheca Speculae Pulcovensis Contentorum Catalogus Systematicus. Pars Secunda Ab Eduardo Lindemanno Elaborata. Edendum Curavit Et Praefatus Est Otto Struve, Speculae Pulcovensis Director.* Petropoli, 1880.

Anonymous Writings

1. Astrologische Beschreibung des erschrecklichen langkschwantzigen und ungehörten Cometen im November des 77. Jares... bei uns erschienen. *Wittemberg, 1578.*
   Houzeau 5605, not located.
2. Kurtze Beschreibung des grossen Kometen von 1577. Von zwei Liebhabern. *Nürnberg, 1577.*
   Carl p. 53, not located.

3. Vom Cometen so itz und in Latitudine Meridionale ascendente. Kurtzer Bericht durch ein Liebhaber der Astronomie. *1577.*

Carl p. 53, not located.

Arma, J. F. = Arma, G. F.

4. De significatione stellae crinitae. *Taurini, 1578.* (In Latin and in Italian)

Houzeau 5606, not located.

Baldinus, B. = Baldino, B.

5. De stellis, iisque quae in stellis et in numina conversi dicuntur homines. *Venetiis, 1579.* (Poem in Latin.)

Houzeau 165, not located.

Bazelius, Ant.

6. Descriptio cometae qui die 14 nov. 1577. apparuit. *Antverpiae, 1578.*

Carl p. 53, not located.

Bazelius, Nicolaus

7. Descriptio Cometae, qui apparuit an. cIↃ.IↃ.LXXVII. xiv. Novemb. unà cum Prognosticis novis anni calamitosissimi cIↃ.IↃ.LXXVIII. *Excudit Antver. Henr. Henricius, 1578.*

Bib. Belg. Valerii Andreae, not located.

8. Een nieuwe Prognosticatie // vanden wonderlijcken ende // ellendighen Jare ons Heeren 1578. // Midsgaders de beschryiunghe vande Comete des voorleden Jaers. Ghecalculeert by *M. Niclaes Bazelius,* Medecijn ende Chirurgijn ordinaris der stede // ende Casselrye van Sinte VVinox-Bergen in VVest-Vlaenderen. // *T'Antwerpen, // By Heyndrick Heyndricksen | op onser Vrouwen Kerchof /// inde Lelie-bloeme. // 1578. //*

Bib. Belg. Gand, 2e série, I, not located.

9. Prognostication // nouuelle, de cest An calamiteux 1578. // Auec description de la Comete veue le 14. // de Nouembre en l'an passé. // Par *M. Nicolas Bazel,* Medecin & Chirurgien de // Bergues S. Winoch, en Flandres. // Auec vne Prophesie for vieille, nagueres trouuée a l'Abbaye vanden Eeckhoutte a Bruges. // *A Anvers. // Chez Henry Heyndricx, au cemitiere nostre Dame, // à la fleur de Lis. 1578.*

Bib. Belg. Gand, 1re série, I, not located.

10. Prognosticon nouum, Anni huius calamitosissimi 1578. Cvm descriptione Cometae visi 14. Nouembris anni elapsi. Autore *D. Nicolao Bazelio*, Bergensium D. Guinochi Medico Chirurgo. Antverpiae. Apud Henricum Henricium, ad coemiterium B. Mariae, sub Lilio. 1578.

B.N. rés. p. v. 49 and *B.M.* T 1753 (11).

de Billy, Himbertus

11. Descrittione della Cometa, vista nel cielo alli Novembre 1577. *Lyone, 1580.*

Carl p. 54 and *Struve, I,* 787, not located.

12. Description, Et Ample Discovrs prognostic du Comete, qui s'est monstré au ciel le douzieme iour de Nouembre, mil cinq cens septante sept, enuiron les cinq heures du soir : & est esuanouy, & disparu le trentieme iour de Decembre : & commencera produire ses effects vers le feste des Roys, en l'an 1578. qui dureront longuement. Par *M. Himbert de Billy*, natif de Charlieu en Lyonnois, disciple de noble Corneille de Montfort, dict de Blockland, &c. A Lyon, Par Benoist Rigavd. 1578. Auec permission.

B.N. V 21083.

Bosius, Jo. Andreas

13. De Significatv Cometarvm Dissertationes et Jvdicia Doctorvm Hominvm : collecta, emendata, & Cometomanticae nostri temporis opposita a *Jo. Andrea Bosio.* Singulorum nomina ac seriem Indiculus praesationi subjectus indicabit. Jenae, Typis & Sumtu Georgii Segenvvaldi, An. Chr. cIↃIↃcLXV. (a collection from *Dudith, Erastus,* and others.)

B.M. 523. e. 23.

Bovius, Zefiriele T.

14. Dechiaratione a confutazione dell' eccel. *M. A. Raimondo* intorno all' apparitione della cometa apparsa alì 9 Novembre 1577. *Verona, 1578.*

Houzeau 5595, not located.

15. Trattato contra le sinistre opinione d'*A. Raymondo* et *G. Mazaro* in materia della cometa, 1577. *Verona, 1578.*

Houzeau 5596, not located.

Brahe, Tycho

16. Astronomiae instauratae mechanica. *Propria authoris typo-*

graphia, Wandesburgi in arce Ranzoviana prope Hamburgum sita, 1598. (The British Museum has the presentation copy to *Thaddeus Hagecius ab Hayck.*)

B.M. C. 45. h. 3, located but not consulted.

17. Astronomiae instauratae progymnasmata, quorum haec prima pars de restitutione motuum solis et lunae, stellarumque inerrantium tractat, et praeterea de admiranda nova stella anno 1572 exorta luculenter agit. *Coepta Uraniburgi, absoluta Pragae, 1610.*

B.M. 531. h. 7, located but not consulted.

18. Astronomiae instauratae progymnasmata. Pars prima, inchoata Uraniburgi, absoluta Pragae, 1602. Liber secundus, inchoatus Uraniburgi, absolutus Pragae, 1603.

Struve, I, 85 and 148, not located.

19. T. B. Epistolarum Astronomicarum libris quorum, primus hic *Gulielmi Hassiae Lantgravii* ac ipsius Mathematici *(C. Rothmannus)* literas unaque responsa ad singulas complectitur. *Uraniburgi, 1596.*

B.M. 50. c. 24, located but not consulted.

20. *Tychonis Brahe* Dani De Mvndi Aetherei Recentioribvs Phaenomenis Liber Secvndus Qui Est De Illvstri Stella Cavdata ab elapso ferè triente Nouembris Anni 1577, vsq; in finem Ianuarij sequentis conspecta. Vranibvrgi Cvm Privilegio. *Vranibvrgi In Insula Hellesponti Danici Hvenna imprimebat Authoris Typographus Christophorus Vveida. Anno Domini. M.D.LXXXVIII.*

H.C.L. Astr. 310.5 *

Buch, G.

21. Beschreibung von der zugehörigen Eigenschaften und natürlichen Influenzen des Cometen, so 1577 erschien. *1577.*

Houzeau 5602, not located.

Busch, G[eorgius]

22. Von den Würckungen des Cometen. *Erfurt, 1577.*

Carl p. 53, not located.

Caesius, Georgius

23. Catalogvs, Nvnqvam Antea Visvs, Omnivm Cometarvm Secvndvm Seriem Annorvm A Dilvuio conspectorum, vsq; ad hunc praesentem post Christi natiuitatem 1579 annum,

cum portentis seu euentuum annotationibus, & de Cometarum in singulis Zodiaci signis, effectibus : ex quibus prudens lector posthac facilimè de quouis Cometa iudicare poterit, &c. ex multorum Historicorum, Philosophorum & Astronomorum, quorum praefatio mentionem facit, scriptis, memoriae cáusa, & propter alias multiplices vtilitates, plurimo labore & diligentissima inquisitione collectus, & dedicatus Amplissimo, Prvdentissimoqve Senatvi Inclytae Reipub. Noribergensis, à *M. Georgio Caesio* Pastore In Oppidvlo Leutershausen : Et eiusdem Iudicium de Cometa nuper in fine anni 77. elapsi viso. *Noribergae Excudebat Valentinus Furmannus. Anno. M.D.LXXIX.*

C.D.H. and *B.M.* 8560. aa. 32.

24. Chronick / Oder ordentliche verzeichnuss vnnd beschreibung aller Cometen / von der algemeinen Sündflut an / nach erschaffung der Welt 1656. biss auff dis gegenwertiges itztlauffends nach Christi vnsers Herrn vn Seligmachers geburt 1579. Jar / vnd was darauff für zufell / straffen vnd verenderungen erfolget / von Kriegen / Theurung / Pestilentz / etc. Auch ein sonderliche erklerūg vnd Exempel / was der Cometstern durch alle 12. Himlische zeichen wirckung sey : Auss welchem der vernünfftige Leser forthin von einem jeden Cometen leichtlich wird vrtheilen können / rc. Auss vilen Scribenten mit sonderm fleiss vnd bedencken / auch auff das kurtzest zusamen gezogen / Durch *M. Georgium Caesium* itzt zu Leutershausen. *Gedrnckt zu Nürnberg / bey Valentin Fuhrman. Anno 1579.*

C.D.H. and *B.M.* 8561. aa. 9.

Camerarius, Ioachimus

25. De Eorvm Qvi Cometae Appellantvr, Nominibvs, Natvra, causis, significatione, Cvm Historiarvm Memorabilivm Illvstribus exemplis, Disputatio atque narratio *Ioachimi Camerarii Pabeperg.* edita. 1578. Lipsiae. *imprimebat Iohannes Steinman. Anno M.D.LXXVIII.* (This is sometimes wrongly catalogued, ie. in " B " 2584, under " Papeberg." In the copy of this work belonging to the Bibliothèque Nationale, opposite page 2 is " Figura I pag. 4 "

TYCHONIS BRAHE DANI

DE

MVNDI AETHEREI

RECENTIORIBVS

PHAENOMENIS

LIBER SECVNDVS

QVI EST DE ILLVSTRI STELLA CAVDATA

ab duplo fere triente Nouembris Anni 1577. visa,

in finem Ianuarij sequentis

conspecta.

BIBLIOTHECA REGIA HAFNIENSIS

BIBLIOTHECA REGIA HAFNIENSIS

VRANIBVRGI

CVM PRIVILEGIO.

a) The title page of the first edition of TYCHO BRAHE's book on the comet of 1577, " ... De Illvstri Stella Cavdata..." the outstanding work on that comet. In the original, the line " Liber Secundus, " from " L " to " s " inclusive, measures 90 mm. By courtesy of the Harvard College Library.

VRANIBVRGI

In Insula Hellesponti Danici Hvenna imprimebat Authoris Typographus Christophorus Vtzida.

ANNO DOMINI.

M. D. LXXXVIII.

b) The last page of the first edition of TYCHO BRAHE's work. By courtesy of the Harvard College Library.

DE STELLA

INVSITATA ET NOVA,

QVÆ MENSE NOVEMBRI,

anno 1572. conspici cœpit.

ET DE

COMATO SIDERE,

QVOD HOC MENSE NOvembri Anno 1577. vidimus.

Commonefactiones in Schola proposita

A

DAVIDE CHYTRAEO.

ROSTOCHII

ANNO M. D. LXXVII.

c) The title page of the Latin edition of CHYTRAEUS' work on the comet of 1577. In the original, the line above " M.D.LXXVII." measures 48 mm. By courtesy of the British Museum.

Vom

Newen Stern/

Welcher Anno M. D. LXXII. im

November erschienen.

Vnd vom

Cometen/

Welchen wir im November dieses lauffenden M. D. LXXVII. Jars/ biß noch jetzund sehen.

Erinnerung

D. DAVIDIS CHYTRÆI in Latein gethan.

Verteutscht durch M. IACOBVM FRAETORIVM Pomeranum zu Rostock.

Cum Priuilegio.

Gedruckt zu Rostock durch Jacobum Lucium.

Anno 1577.

d) The title page of the German edition of CHYTRAEUS' work on the comet of 1577. In the original, the word " Erinnerung " measures 22 mm. By courtesy of the Columbia University Library.

C. D. HELLMAN.

Kurtze Beſchreibunge
des Cometen / welcher iſt geſehen worden am Himel Anno 1577. den 11. Nouembris / Auch von etlichen Wunderzeichen die vorher gegangen ſein / zu trewer warnung an alle Chriſten geſchrieben.
Durch
Johan Creat: T.
ANNO 1577

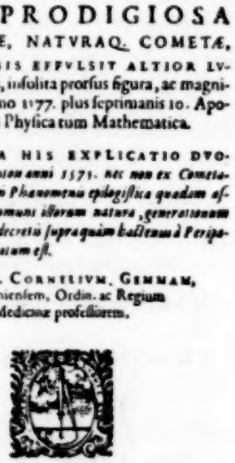
Joelis Cap. 2.

Ich wil wunder geben / ſpricht Gott der HERR / am Himel / vnd auff Erden / nemlich Blut vnd Fewr / vnd Rauchdampff / die Sonne in Finſternis / vnd der Mond in Blut verwandelt werden / ehe denn der groſſe Tag des HERRN kömmt.

a) The title page of CREAT's decidedly unscientific work on the comet of 1577. By courtesy of the New York Public Library.

b) The title page of DASYPODIUS' work on the comet of 1577. The type of figure here shown is very common in sixteenth century cometary tracts. In the original, the line above " Imum coeli." measures 111,5 mm. By courtesy of the Harvard College Library.

c) The verso of A_{iv} of DASYPODIUS' book, showing the very common conception of three " types " of comets. By courtesy of the New York Public Library.


DE PRODIGIOSA
SPECIE, NATVRAQ. COMETÆ,
QVI NOBIS EFFVLSIT ALTIOR LVNÆ ſedibus, inſolita prorſus figura, ac magnitudine, anno 1577. plus ſeptimanis 10. Apodeixis tum Phyſica tum Mathematica.
ADIVNCTA HIS EXPLICATIO DVORVM Chaſmatum anni 1571. nec non ex Cometarum plurium Phænomena epilogiſtica quædam aſſertio de communi illorum natura, generationem eorúm atque decretis ſupraquàm hactenus à Peripateticis annotatum eſt.
PER D. CORNELIVM GEMMAM,
Louanienſem, Ordin. ac Regium Medicinæ profeſſorem.
ANTVERPIÆ,
Ex officina Chriſtophori Plantini,
Architypographi Regij.
M. D. LXXVIII.

d) The title page of CORN. GEMMA's often cited book on the comet of 1577. In the original, the line " De Prodigiosa " measures 80 mm. The book is a product of the famous PLANTIN press. By courtesy of the Harvard College Library.

C. D. HELLMAN.

a) The path of the comet as observed by CORNELIUS GEMMA, taken from his book. In the original, from 10 to 30 on the scale measures 38 mm. By courtesy of the Harvard College Library.

b) The path of the comet as observed by THADDAEUS HAGECIUS AB HAYCK, taken from his book. It may be of interest to the reader to compare the maps of GEMMA, who observed in the Low Countries, and of HAGECIUS, who observed from Prague. In the original, the line on the outside of the right-hand side of the page measures 173 mm. By courtesy of the Bibliothèque Nationale.

Astrologische Beschreibung
Des erschrecklichen langk-
schwentzigen vnd vngeheuren Cometen / so im
Novembre des 77. Jares / in duodecimorio Capricorni, mit dem
Rucken gegen dem Christmonat / bey uns erstlich erschienen / vnd fast
bey gantzer Menschen gedencken / vnd auch des dritte doder . .
cumerum Zodiaci erreicht hat.
Nach Anweisung vnd Lehr des hochgelarten vnd weitberuhmten
Medici vnd Astrologi D. HIERONYMI
CARDANI M.
Gestellet vnd Verfasset durch
M. IOACHIMVM GROPLERVM BRAN-
denburgensem, der Mathematum vnd Physicæ Studiosum.
Gedruckt zu Wittenberg durch Clemens Schleich vnd Johannem
Schultz / Im Jar M. D. LXXVII.

c) The title page of GROPLERUS' treatise on the comet of 1577. In the original, the line below "Gestellet vnd Verfasset / durch," the top line of the figure, measures 72,5 mm. From the library of C. D. HELLMAN.

DISCOVRS SVR
CE QVE MENACE DE-
VOIR ADVENIR LA COMETE,
apparüe à Lyon le 12. de ce mois de Nouembre 1577.
laquelle se voit encores à present.
Par M. François Iunctin natif d'Florence
& Mathematicien
SEPTENTRION
MERIDIES
A PARIS,
Chez Gervais Mallot, rue S. Iaques à l'enseigne de l'Aigle d'Or.
1577.
AVEC LA COPIE DE LYON.

d) The title page of the Paris 1577 edition of IUNCTINUS' work on the comet of 1577. In the original, the first line, "Discovrs Svr," measures 87 mm. By courtesy of the Bibliothèque Nationale.

C. D. HELLMAN.

DESCRIPTION

DE L'ESTRANGE ET PRODIGIEVSE COMETE, APPARVE LE VNZIESME iour de Nouembre, ſis heures du ſoir.

Auec la figure du lieu de ſa ſituation, en la baſſiſſure meſme du Ciel, & la preſdiction de ſes Vrayes & ſignifiables effets. Plus l'approbation tiree par Meſſeurs Medeſimes, que ces Prophanes que laſdites Cometes n'apparoiſſent aucunes fois vaines.

Par treſ-docte & excellent Aſtrologue M. François Liberati, de Rome.

A PARIS.

Pour Iean de Laſtre, libraire, demourant en la rue S. Iean de Latran, pres le College de Cambray.

M. D. LXXVII.

AVEC PRIVILEGE DV ROY

a) The title page of LIBERATUS' work on the comet of 1577. In the original, the top line of the figure measures 66 mm. From the library of C. D. HELLMAN.

NOTABLE

Diſcours de M. Iacques MARZARI, VICENTINO, TOVchant la Comette apparue au moys de Nouembre 1577.

Auquel eſt traité des occaſions d'icelle, de ce qu'elle peut predire & ſignifier & de la reigle de viure en ce temps, pour obuier à la maligne affection d'icelle.

Traduit de nouueau, d'Italien en langue Françoiſe.

A LYON,

PAR IEAN PATRASSON.

M. D. LXXVIII.

Auec permiſſion.

b) The title page of MARZARUS' "Diſcours" on the comet of 1577. In the original, the line below "langue Françoiſe," measures 78 mm. The figure shown is a common one. It was used by the same printer on the title page of the French edition of FIORNOUELLUS' work. By courtesy of the British Museum.

DISCOVRS

SVR LA COMETTE APARVE EN L'AN mille cinq cents ſeptante ſept, ès terres de Ferrare,

Auec l'obſeruation des effets de pluſieurs autres Cometes apparues en diuers temps antiques & modernes.

Recueillis par M. Iean Maria Fiornouelli.

A LYON,

PAR IEAN PATRASSON.

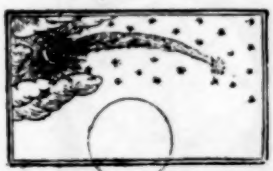
M. D. LXXVIII.

Auec permiſſion.

c) The title page of the French edition of FIORNOUELLUS' treatise. In the original, the upper outer border of the figure measures 77 mm. By courtesy of the Bibliothèque Nationale.

Mario Napolitano, Ai Lettori.

SCiocco giuditio, e pur ſolle intelletto,
Che ogn'hora penſi, e contemplando vai
Chi fù principio de la pace, e guai,
Chi ferma, e muoue ogni celeſte tetto.
Chi diè a l'Antica Madre forza, ò effetto,
Onde preſer la lume i Santi rai,
Chi vnì i quattro humori inſieme, ſai
Che queſto chiude il gran Monarcha in petto.
Volgi gl'Antichi, e moderni volumi,
Adopra ſquadri, gran miſure, e ſeſti,
Contempla ſotto i piè, ſopra la teſta,
Che quel che tu non ſai, lo ſanno i Numi:
Queſto humano non è, ma de' celeſti
Spirti, lo giuoco, l'effetto, e la feſta.



IN FERRARA Per Vittorio Baldini,
Con licenza de' Superiori.

d) The final page of the Italian edition of THURNEYSERUS' tract on comets. The figure is the same as that on the title page of FIORNOUELLUS' book and on that of MARZARUS', although the book was printed by a different printer. By courtesy of the Bibliothèque Nationale.

a) The title page of the Leipzig edition of STEINMETZ' treatise on the comet of 1577. In the original, the line below "Mitternacht," above the figure, measures 118 mm. By courtesy of the New York Public Library.

einfalle/Land vnd Leute jemmerlich verderbe vnd vmbringe. Gott wolte gnediglich seine heilige Christliche Kirche erhalten/ dem Türcken/dem Erbfeinde seines Göttlichen Namens/ vnd allen andern Tyrannen steweren vnd wehren/ vnd vber dieselbe seinen gerechten zorn ausgiessen/ vnd allen die an jhn gleuben vnd jhr vertrawen auff sein Göttliches Wort/ Verheissung vnd Zusage setzen/ viel frölicher ruhiger zeit vnd Jahre aus gnaden geben/ AMEN.

Gedruckt zu Leiptzig/
bey Nickel Nerlich
Formschneider.

b) The last page of the Leipzig edition of STEINMETZ' treatise on the comet of 1577. In the original, the line "bey Nickel Nerlich" measures 90 mm. By courtesy of the New York Public Library.

Von dem Cometen welcher
im Nouember des 1577. Jars erstlich erschie-
nen/vnd noch am Himmel zusehen ist/wie er von Abend
vnd Mitnag/gegen Morgen vnd Mitternacht zu/seinen fortgang ge-
habt/observiert vnd beschrieben in Leypzig.
Mitternacht.
Morgen
Abendt
Mittag.

c) The title page of the Augsburg edition of STEINMETZ' treatise on the comet of 1577. In the original, the line below "Mitternacht," above the figure, measures 117 mm. From the library of C. D. HELLMAN.

durch die lange erfahrung von 1500. Jahren her/ confirmirt sind worden/ anzusehe/ zeigen sie an/ ob wol die Würckung vnd Effecten dieses Cometen hefftig in den Landen gegen Abend vnd Mittage zu gelegen/ sich erzeigen vnd mercklich ergehn werden/ das doch vnser Patria als Deutschland/ seines wegs dauon wird aufgeschlossen sein. Nach dem er in dem Zeichen/ vnter welches Deutschland auch gehöret vnd gelegen/ erstlich angekommen vnd erschienen/ vnnd forder immer weiter vnd weiter nach vnserm Gebiet vnnd Herrligkeit zu gestigen vnd gestanden: Vnnd dieweil er auch nahe dem Occident gestanden/ gibt er die würckung langsam/ aber sehr hefftig vnd langwerende/ Wie denn auch solches Saturnus/ welcher ganz nahe anfenglich bey dem Cometen gestanden/ vnd vber dem er seiner entzündung herkompt ist/ bezeuget. Weil auch der Schwantz röthlich oder Martialisch ist/ sonderlich im anfang gesehen/ das Corpus aber vor sich selbst liecht vnd helle/ vnd der Veneri oder Jupiter nie fast vngleich/ von welchen wir vermals gemeldet/ er entzündet sein mag/ so schleusst der Ptolomeus vnd seine Interpretes/ das er harte Kriege vnd geschwinde Seuchen/ wegen des Mars erregen werde/ Aufrührische vnd geschwinde Regimenta/ vnd wie auff dem 100. Jahrestime zu sehen/ ist zubesorgen/ das nicht ein frembder Feind/ als der Türckt mit seinem anhang einfalle/ Land vnnd Leute jemmerlich verderbe vnnd vmbringe. Gott wolte gnediglich seine heilige Christliche Kirche erhalten/ dem Türcken/ dem Erbfeinde seines Göttlichen Namens/ vnd allen andern Tyrannen steweren vnd wehren/ vnnd vber dieselbe seinen gerechten zorn ausgiessen/ vnd allen die an jn Glauben/ vnnd vertrawen auff sein Göttliches Wort/ Verheissung vnd zusage setzen/ viel frölicher ruhiger zeit vnd Jare auf gnaden geben/ Amen.

Gedruckt zu Augspurg/ durch
Michael Manger.

d) The last page of the Augsburg edition of STEINMETZ' treatise on the comet of 1577. In the original, the line "Gedruckt zu Augspurg / durch" measures 75,5 mm. From the library of C. D. HELLMAN. I have been unable to find any trace or mention of this edition other than this one copy.

C. D. HELLMAN.

TRAICTÉ

DES COMETES,

OV ESTOILLES CHEVELVES, APPAROISSANTES EXtraordinairement au ciel:

Auec leurs cauſes & effects.

Par Bl. de Vigᵉ.

A PARIS,

Chez Nicolas Cheſneau, rue ſainct Iacques, au Cheſne verd.

M. D. LXXVIII.

AVEC PRIVILEGE DV ROY.

a) The title page of BLAISE DE VIGENÈRE's "Traicté Des Cometes, Ov Estoilles Chevelves..." In the original, the line above " A Paris," measures 47 mm. By courtesy of the Bibliothèque Nationale.

TRAICTÉ

DES COMETES,

OV EXCROISSANCE DE LVMIERE APparoiſſant és eſtoilles.

Par Bl. de Vigᵉ.

A PARIS,

Chez Nicolas Cheſneau, rue ſainct Iacques, au Cheſne verd.

M. D. LXXVII.

AVEC PRIVILEGE DV ROY.

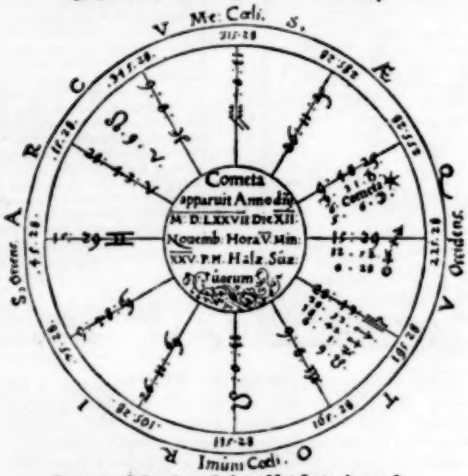
b) The title page of BLAISE DE VIGENÈRE's "Traicté Des Cometes, Ov Excroissance De Lvmiere..." In the original, the line above "A Paris," is 43 mm. in length. From the library of C. D. HELLMAN. I have been unable to find any trace or mention of this work other than this one separate title page, for which there is no book.

COMETA POGONIAS,

OVI ANNO LABENTE 1577. MENSE NOVEMBRI ET DECEMBRI APPARVIT, DEMONstratus vnà cum parallaxi, diſtantia à Centro terræ, & ſignificatione eius.

AVTORE

D. Nicolao Vuncklero, Hale Suevorum Phyſico.



Cum gratia & Priuilegio Cæſareæ Maieſtatis, ad annos Sex.

NORIBERGÆ cIↃ. IↃ. LXXVIII.

c) The title page of WINCKLERUS' treatise, showing an interesting figure. In the original, the word " Avtore " measures 31 mm. From the library of C. D. HELLMAN.

which belongs in C. Gemma's " De Prodigiosa Specie..." (43), and opposite page 18 is " Figura 2. pag. 19.", also from Gemma's work. These figures are not in the Bibliothèque Nationale's copy of Gemma's book although they are clearly indicated in the text. The figures do not appear in C.D.H.'s copy of the Camerarius but do appear in the Harvard College Library copy of the Gemma. Since the Camerarius and the Gemma, together with other tracts, are bound in one volume in the Bibliothèque Nationale, it is reasonable to suppose that, when the volume as it now stands was first made up, those two figures were wrongly placed.)

C.D.H. and *B.N.* V 21080.

Celichius, Andreas

26. Christliche, Notwendige, Nützliche vnd Theologische Erinnerung von dem newen Cometen. *Leipzig, 1578.*

Carl p. 53, not located.

27. Theological Reminder of the New Comet. *Magdeburg, 1578.* (Possibly White translated the title from the German before including it in the text of his book. This would make 27 and 28 alike.)

White, I, 190.

28. Theologische erinnerung von den newen cometen. *Magdeburgk, 1578.*

Struve, I, 787.

Chytraeus, David

29. De Stella Invsitata Et Nova, Qvae Mense Novembri, anno 1572. conspici coepit. Et De Comato Sidere, Qvod Hoc Mense Nouembri Anno 1577. videmus. Commonifactiones in Schola propositae A *Davide Chytraeo.* Rostochii. Anno M.D.LXXVII.

B.M. 532. e. 55.

30. Vom Newen Stern / Welcher Anno M.D.LXXII. im Nouember erschienen. Vnd vom Cometen / Welchen wir im Nouember dieses lauffenden M.D.LXXVII. Jars / vnd noch jtzund sehen. Erinnerung *D. Davidis Chytraei* in Latein gethan. Verdeudscht durch *M. Iacobvm Praetorivm* Profess : zu Rostock. Cum Priuilegio. Gedruckt zu Rostock durch Jacobum Lucium. Anno 1577.

C.U.L. 523.6 Z2 (43).

Cratonus, Joannes

See (37) *Erastus'* " De Cometis..."

Creat, Johannes

31. Kurtze Beschreibunge des Cometen / welcher ist gesehen worden am Himmel Anno 1577. den 11. Nouembris / Auch von etlichen Wunderzeichen die vorher gegangen sein / zu trewer warnung an alle Christen geschrieben. Durch *Johan Creat:* T. Joelis Cap. 2. Ich wil wunder gehen / spricht Gott der Herr / am Himel / vnd auff Erden / nemlich Blut vnd Fewr / vnd Rauchdampff / die Sonne in Finsternis / vnd der Mond in Blut verwandelt werden / ehe denn der grosse Tag des Herren komme. (No date or place of publication and no printer are stated, and the quotation given is on the title page.)

N.Y.P.L. OAI p. v. 105 no. 11.

Crügerus, Petrus

32. Theoremata exegetica de Cometis tam in genere quam in specie de tribus aevi nostri insignioribus, anno nempe 1572, 1577 et praeterito 1604 conspectis. *Dantisci, 1605.*

Carl p. 54 and *Struve, I,* 550 and 762, not located.

Dasypodius, Cunradus

33. Brevis Doctrina De Cometis, & Cometarum effectibus. Per *M. Cvnradvm Dasypodivm.* Argentorati Excudebat N. Vvvriot M.D.LXXVIII.

H.C.L. 24281.1 and *N.Y.P.L.* Reserve.

Duditius, Andreas (Dudith)

See (37) *Erastus'* " De Cometis..."

34. *Andreae Dvditii* Viri Clarissime De Cometarvm Significatione Commentariolvs. In quo non minùs eleganter, quàm doctè & verè, Mathematicorum quorundam in ea re vanitas refutatur. Addidimus *D. Thomae Erasti* eadem de re sententiam. Basileae Ex Officina Petri Pernae. Anno 1579.

C.D.H. and *B.M.* 532. e. 12 (2).

35. De Cometarum Significatione Cl. Virorum *Andreae Duditii* Commentariolus, & *D. Thomae Erasti* sententia. Elias Maior Vratislaviensis denuò edidit, & adjecit *παραδοξν* Breslae, Typis Baumannianis. Impensis Davidis Mulleri,

Bibliopolae Vratise. Anno 1619. (Pages 1-95 are the same as the volume noted as 34, " *Andreae Dvditii* Viri...").

B.M. 8610. a. 26.

Elias Maior

See (35) *Dudith's* " De Cometarum...".

Erastus, Thomas

36. De Astrologia Divinatrice Epistolae *D. Thomae Erasti*, Iam Olim ab eodem ad diuersos scriptae, & in duos libros digestae, ac nunc demum in gratiam ueritatis studiosorum in lucem aeditae, opera & studio *Ioannis Iacobi Grynaei*... [quotation from Origen]... Basileae, Per Petrvm Pernam, M.D.LXXX.

C.D.H. and *B.M.* 718. f. 13 (2).

37. De Cometis Dissertationes Novae Clariss. Virorvm *Thom. Erasti, Andr. Dudithij, Marc. Squarcialupi, Symon. Grynaei.* Ex Officina Leonardi Ostenij, sumptibus Petri Pernae. M.D.LXXX.

B.M. 532. e. 12 (3)—(6) and *B.N.* V 8797 and V 8798. This volume contains the following parts often found catalogued separately :

1. De Cometarvm Significationibvs Ivdicivm *Thomae Erasti* Medicinae in Scola Heydelbergensi Professoris.

   B.M. 532. e. 12 (3) and *B.N.* V 8797.

2. *Andreas Dvdith.* Caes. Consiliarivs, *Thomae Erasto* Philosopho, & Medico Clarissimo, professori in Academia Heidelbergensis. P. D.

   B.M. 532. e. 12 (3) and *B.N.* V 8797.

3. De Cometa In Vniversvm, Atqve De Illo Qvi anno 1577, uisus est, opinio *Marcelli Squarcialupi* Plumbinensis : Ad Ampliss. & sapientem virum *Andream Dvdithivm*, Caesaris Consiliarium.

   B.M. 532. e. 12 (3) and *B.N.* V 8797.

4. De Cometarvm Ortv, Natvra Et Cavsis Tractatvs : In Qvo Aristot. sententia explicatur, & contra *D. Marcellum Squarcialupum* Plumbinensem defenditur À *Thoma Erasto* Medicinae In Schola Heidelbergensi Professore...

   B.M. 532. e. 12 (4) and *B.N.* V 8797.

5. *Andreas Dvditivs Joanni Cratoni* S.

   B.M. 532. e. 12 (5).

6. Commentarii Dvo, De Ignitis Meteoris Vnvs : Alter De Cometarvm Cavsis atque significationibus : Conscripti per *Simonem Grynaevm* Med. & Math. Accessit eiusdem Observatio Cometae, Qvi Anno superiore 77. & ab initio 78 fulsit. Et Dispvtatio De Invsitata magnitudine & figura veneris conspecta in fine anni 1578, & ad initium cIↃIↃcLXXIX.

B.M. 532. e. 12 (6) and *B.N.* V 8798.

These parts are indicated on the verso of the title, which reads :

" Iudicium *Tho. Erasti* de Cometis.

Andr. Dudithij Epistola ad *Erastum* de *Squarcialupi* sententia.

Squarcialupus de Cometis aduersus *Erastum.*

Erasti aduersus *Squarcialupum* defensio.

Dudithij de Cometis Epistola ad *Ioan Cratonem.*

Simonis Grynaei Commentarij duo, vnus de Ignitis Meteoris : alter de Cometarum causis."

In the British Museum the six parts are all bound together in the proper sequence, although the sixth part could very easily be mistaken for another and separate volume. The Bibliothèque Nationale copy is divided in two parts, bound separately, and apparently considered as two separate books. They have the catalogue numbers of V 8797 and V 8798. The first volume contains the first four parts and ends with the page S_3. The Cratonus which should be on the leaves T_1-Y_4 is not contained in either volume. The second volume contains the sixth part.)

38. Disputatio de auro potabile... adjectum est... de indicatione cometarum. *Basle, 1578.*

B.N. 8º Te^{131} 16, located but not consulted.

See (34) *Dudith*'s " *Andreae Dvditii* viri..."

See (35) *Dudith*'s " De Cometarum Significatione..."

Fabricius, Paulus

39. Indicium (or Judicium) de cometa qui anno 1577 conspectus est. *Viennae, 1577.*

Carl p. 53 and *Houzeau* 5590, not located.

Fiornouellus, Joannes Maria

40. Discorso sopra la cometa apparsa nell' anno presente 1577,

con le osservationi degli effetti di molte altre comete apparse in diversi tempi antichi e moderni. *Ferrara, 1577.*

Houzeau 5594, not located.

41. Discovrs Svr La Comette Aparve En L'An mille cinq cents septante sept, és terres de Ferrare, Auec l'obseruation des effets de plusieurs autres Comettes aparues en diuers temps antiques & modernes. Recueillis par *M. Iean Maria Fiornouelli.* A Lyon, Par Iean Patrasson. M.D.LXXVIII. Auec permission. (The Bibliothèque Nationale copy of this work had, in the summer of 1931, the signature B of Marzarus' work in place of the B of Fiornouellus' and vice versa.)

B.N. V 21092*bis* and *B.M.* 531. e. 28 (1).

42. Opusculum de cometis. *Ferrara, 1578.*

Houzeau 5598, not located.

Gemma, Cornelius

43. De Prodigiosa Specie, Naturaq. Cometae, Qvi Nobis Effvlsit Altior Lvnae sedibus, insolita prorsus figura, ac magnitudine, anno 1577. plus septimanis 10. Apodeixis tum Physica tum Mathematica. Adivncta His Explicatio Dvorum Chasmaton anni 1575. nec non ex Cometarum plurium Phaenomenis epilogistica quaedam assertio de communi illorum natura, generationum causis atque decretis supra quàm hactenus à Peripateticis annotatum est. Per *D. Cornelivm Gemmam*, Louaniensem, Ordin. ac Regium Medicinae professorem. Antverpiae, Ex officina Christophori Plantini, Architypographi Regij. M D.LXXVIII. (See the comment under Camerarius' treatise concerning the Bibliothèque Nationale's copy of this work.)

H.C.L. 24281.12 and *B.N.* V 21081 and *C.U.L.* 523.6 G 28.

Graminaeus, Theod. (Gras, T.?)

44. Cometae anni domini 1580 physica explicatio, et ejusdem cum eo, qui anno 1577 apparuit, analogica collatio. *Cologne, 1581.*

B 2498 (in Obs. roy. à Bruxelles) and *Carl* p. 55, not located.

45. Weltspiegel oder Algemeiner widerwertigkeit, dess Fünff-

ten Kirchen Alters, kürtze Verzeignuss. Darinnen dess Cometen u.s.w. *Cöln, 1578.*

Carl p. 53 and *Struve, I,* 789, not located.

the comment under (41) *Fiornouellus'* " Discovrs..."

46. Weltspiegel; speculum mundi de minitante cometa anni 1577. *Kölln, 1578.*

Houzeau 5608, not located.

Groplerus, Ioachimus

47. Astrologische Beschreibung Des erschrecklichen / langkschwentzigen vnd vngehewren Cometen / so im Nouembre des 77. Jares / in dodecatimorio Capricorni, mit dem Newen Liecht des Christmonats / bey vns erstlich erschienen / vnd fast drey gantzer Monshein gewehret / vnd auch das dritte dodecatimorion Zodiaci erreicht hat. Nach Anweisung vnd Lehr des hochgelarten vnd weitberümbten Medici vnd Astrologi *D. Hieronymi Cardani* M. Gestellet vnd Verfasset / durch *M. Ioachimvm Groplervm* Brandenburgensem, der Mathematum vnd Physicae Studiosum. Gedruckt zu Wittenberg durch Clement Schleich vnd Antonium Schön / Im Jar M.D.LXXVIII.

C.D.H.

Grynaeus, Ioannes Iacobus

See (36) *Erastus'* " De Astrologia..."

Grynaeus, Simon

See (37) *Erastus'* " De Cometis..."

Guilielmus IV

See *William IV.*

Hagecius ab Hayck, Thaddaeus

48. Descriptio Cometae, qui apparuit Anno Domini M.D.LXXVII. à IX. die Nouembris usque ad XIII. diem Ianuarij, Anni &c. LXXVIII. Adiecta est Spongia contra rimosas & fatuas Cucurbitulas *Hannibalis Raymundi,* Veronae sub monte Baldo nati, in larua Zanini Petoloti à monte Tonali. Avtore *Thaddaeo Hagecio ab Hayck.* Pragae Excusum typis Georgii Melantrichi ab Auentino, Anno à Christo nato 1578.

B.N. V 7793.

See (16) *Brahe's* " Astronomiae instauratae mechanica," British Museum copy.

Hagecius, T. (possibly Thaddaeus Hagecius ab Hayck)

49. epistola ad *Martinum Mylium*, in qua examinatur sententia *M. Moestlini* et *Helisaei Roeslin* de Cometa 1577. *Gorlicii, 1580.*

Carl p. 54 and *Struve, I*, 787, not located.

50. Litterae *Hagecii* ad *Mylium* 22. Sept. 1578 Pragis datae. (Manuscript).

Struve, I, 787, not consulted.

Heerbrand, Jacob

51. Ein Erndt vnd Herbst Predig. Auss dem 26. Capittel / des fünfften Buch Mosis. Zur Dancksagūg für die reiche Ernd vn̄ Herbst / dises gegenwertigen Jars. Geschehen den 9. Wintermonats zů Tübingen. Durch *Jacob Heerbrand* / Doctor vnd Professorn der H. Schrifft daselbst. Getruckt zů Tübingen / bey Alexander Hock / an der Burgsteyg / Anno 1578.

B.M. C 68. h. 8 (12).

52. Ein Predig von dem erschrockenlichen Wunderzeichen *Tübingen, 1578.*

Carl p. 53 and *Struve, I*, 787, not located.

53. Ein trewe Warnung vnd gutthertzige Vermanung zur Bůss / an die allgemeine Christenheit / vnd sonderlich Noch Teutschland / vber das schröckliche Wunderzeichen / den Cometen / oder Pfawenschwantz / der jetzt eine gutte zeitlang am Himmel ist gesehen worden. Auss der Christlichen vnd Eyfferigten Predig des Ehrwürdigen vnd Hochgelehrten Herrn *D. Jacob Heerbrands* / gehalten zu Tübingen / den 7. Nouemb. Anno 1577. Gestelt durch *Vitalem Kreidweiss* / diser zeit Schulmeister zu Leonberg. Getruckt zu Tübingen / durch Alexander Hock / an der Burcksteig. 1578.

B.M. 11521. ee. 30 (4).

54. Von dem erschrockenlichen Wunderzeichen. *Tübingen, 1577.*

White, I, 184 footnote, not located.

Henischius, G.

55. Indicium de pogonia ad finem 1577 conspecto. *Augustae, 1578.*

Carl p. 53 and *Struve*, not located.

Hooker, J.

56. The events of comets or blazing stars, made upon the sight of the comet Pagania, which appeared in November and December 1577. *London, 1577.*

Houzeau 5601, not located.

Huernius, Ioannes

57. De Historie / Natuere / ende Beduidenisse der erschrickelicke Comeet / die geopenbaert is int Jaer ons Heren 1577. Dorch *D. Ioannem Hvernivm* Vltraiectinum Medicum & Astronomum. Des Heeren Dach compt gruwelick / toornich / ende grimmende / om dat Landt te verdestruëren / ende de Sundaers daer wt te roeyen. Want de Sternen aenden Hemel / ende synen Orion en schynt niet claer. Esa. 13. Gedrückt zu Cölln / durch Niclās Bohmbargen. Men verköstse by Willem Iansen Briefmaler, by der Godte Genade.

B.M. T 1753 (11).

58. De natura et praesagio horrendi cometae qui anno MDLXXVII orbem terrarum terruit. *Coloniae, 1577.*

Houzeau 5592, not located.

59. Geschichte, Natur vnd Bedeutung des Cometen. *Cöln, 1577.*

Carl p. 53, not located.

Ioachimicus, Iohannes Praetorius

See *Praetorius, Iohannes.*

Ireneus, Christoph.

60. Prognosticon auf den Cometen 1577. *Alphordiae, 1578.*

Houzeau 5610, not located.

61. Prognosticon Aus Gottes Wort nötige Erinnerung / Vnd Christliche Busspredigt zu dieser letzten bösen Zeit An hohe vnd nider Standes Deutsches Landes : Auff den Cometen / so von Martini des 1577. Jars / biss zum Eyngang des 1578. Jars gesehen. Sampt Erzehlung vieler Cometen vnd anderer schrecklicher Zeichen / vnd was allwegen darauff erfolget. *M. Christoph. Ireneus.* Anno M.D.LXXVIII. (This might possibly be the same as the work above, no. 60, but " Alphordiae " does not appear in it.)

C.D.H.

Iunctinus, Franciscus

62. Discovrs Svr Ce Qve Menace Devoir Advenir La Comete, apparüe à Lyon le 12. de ce mois de Nouembre 1577. laquelle se voit encores à present. Par *M. François Iunctini* grand Astrologue & Mathematicien. A Paris, Chez Geruais Mallot, rue S. Iaques à l'enseigne de l'Aigle d'Or. 1577. Iovxte La Copie De Lyon. (The copy of *C.D.H.* has been cut down so that the line " Iovxte La Copie..." does not appear. It could be supposed that there is a Lyon copy prior to this 1577 Paris copy.)
B.N. V 21093 and *C.D.H.*

63. Discours sur ce que menace devoir advenir la comète apparue à Lyon le 12 Nov. 1577 *etc. Lyon, 1578.*
Poggendorff, I, 1211 and *Houzeau* 5599, not located.

64. Tractatio vtilis & lectu digna de Cometarvm Cavsis, Effectibvs, Differentiis, Et eorundem proprietatibus. Cvm Plana Et Expedita Declaratione Eventvvm, quos diuersos pro diuersitate Planetarvm & Signorvm Zodiaci sortiuntur, tam ad communem vitae vsum necessaria, quàm ad natiuitatum figuras dextrè dijudicandas idonea, ex *Francisci Iunctini* Florentini voluminibus excerpta. 1580. Lipsiae. *Imprimebat Ioannes Steinman.*
C.D.H.

Kreidweiss, Vitalis

See (53) *Heerbrand*'s " Ein trewe Warnung vnd..."

Launer, Mart.

65. Beschreibung des Cometen. *Neysse, 1578.*
Carl p. 53, not located.

Lemoniensis, Petrus

66. Judicium de stella comata. *Ms. in the library of Cambridge University.* (*Houzeau* lists this item, no. 5591, under sixteenth century writings. According to the secretary of the Library of Cambridge University the manuscript, by " Petrus Lemoviensis," deals with the comet of 1298. Because of this disagreement, I have tried definitely to identify the author of the manuscript, but up to now without success, although I realize that he might be one of the " Pierres " mentioned by Chevalier as living in the thirteenth century, such as Pierre de Lemet and Pierre

de Limoges. I expect to look further into this matter at some future date, but should be grateful for any information concerning the author of the manuscript.)

Houzeau 5591, not seen.

Liberatus, Franciscus

67. Description De L'Estrange Et Prodigievse Comete, Apparve Le Vnziesme iour de Nouembre, à six heures du soir. Auec la figure du lieu de sa scituation, en la huictiesme maison du Ciel, & la prediction & intelligence de ses effroyables effets. Plus l'approbation tant par Historiens Ecclesiastiques que Prophanes que lesdites Cometes n'apparurent oncques pour neant. Par tres-docte & excellent Astrologue *M Françoys Liberati*, de Rome. A Paris. Pour Iean de Lastre, libraire, demourant en la rue S. Iean de Latran, pres le College de Cambray. M.D.LXXVII. Avec Privilege Dv Roy.

C.D.H.

Longus, Io. Bernardinus

68. *Io : Bernardini Longi*, Phylosophi Neapolitani. De Cometis Disputatio. Ad Illvstrissimvm, Et Eccellentissimum Marchionem Mondeyar, in Neapolitano Regno Proregem. Neapoli Apud Horatium Saluianum : 1578.

C.D.H.

69. Traicté des Cometes du Seigneur *I. Bernard Longve* Philosophe & Medecin... Mis en François par *Charles Nepvev*, Chirurgien du Roy... Plus vn Recueil de la peste tres approuué & experimenté par ledict *Nepueu*. Paris, Claude de Monstroeii, 1596.

B.N. V 21091, located but not consulted.

Maestlinus, Michael

70. Obseruatio & demonstratio Cometae Aetherei, Qvi Anno 1577. Et 1578. Constitvtvs In Sphaera Veneris, Apparvit, Cvm Admirandis eius passionibus, varietate scilicet motus, loco, orbe, distantia à terrae centro, &c. adhibitis demonstrationibus Geometricis & calculo Arithmetico, eiusmodi de alio quoquam Cometa nunquam visa est. Avtore *M. Michaele Maestlino* Goeppingensi. Tubingae, excudebat Georgius Gruppenbachius, 1578.

B.N. V 7918.

See (49) *Hagecius'* " epistola..."

Marzarus, Iacobus

71. Notable Discours de *M. Iacques Marzari*, Vicentino, Tovchant la Comette apparue au moys de Nouembre 1577. Auquel est traité des occasions d'icelle, de ce qu'elle peut predire & signifier : & de la reigle de viure en ce temps, pour obuier à la maligne affection d'icelle. Traduit de nouueau, d'Italien en langue Françoise. A Lyon, Par Iean Patrasson. M.D.LXXVIII. Auec permission. (See concerning the Bibliothèque Nationale's copy of this work.)

B.M. 531. e. 28 (3).

72. Italian edition of the " Notable Discours..."

The existence of the Italian edition is implied on the title page of the French edition.

See (15) *Bovius'* " Trattato contra le sinistre opinione..."

Meyne, M. = *Meine, M.*

73. Von aller Geschlet der Cometen, jeder Zeit, wan die Erscheinen zu gebrauchen, und von dessen Wirckungen, der uns zu Dantzigk dem 12. November 1577 erschienen ist. *Dantzigk, 1578.*

Houzeau 5611 and *Struve, I*, 787, not located.

Misocacus, W. (Misocacus, Wilhelm, is possibly a pseudonym for *Rasch, J.*)

74. Observationes astronomicae pertinentes ad novam cometam qui visus est jam anno 1578. *Dantisci, 1578.* (Carl writes " ... jam anno 1577.", but this is probably a mistake, as can be seen from the meaning of the phrase.)

Carl p. 53 and *Struve, I*, 787, not located.

Muller, Samuel

75. Astronomische Beschreibung dess Cometen / so zů ende dises verloffenen 1577. Jars erschinen / sampt seiner bedeutung. Zů Ehren vnd Wolfart / Dem Hochwirdigen Fürsten vnnd Herren / Herren Eberharten / Appte des Ehrwirdigen Fürstlichen Stiffts zů Kempten / seinem gnedigen Herren. Durch *Samuelem Müllerum* Physicum Campidonensem. *Printed by Valentin Schönig at Augsburg, 1578.*

G.S. owns a photostatic copy of this book.

Mylius, Martinus

See *T. Hagecius*' (49) " epistola..." and (50) " Litterae..."

Nagelius, Paulus

76. Ander Theil Des in 1618. Jare erschienen vnd verschienenen Cometen / so an diesem Orte zur Proba begreifft / eine kurtze warhafftige deutung vnd interpretation Des newen wunder=Sterns 1572. vnd des Cometen 1577. erschienen / wird auch angezeigt wie der Comet 1577. mit den Cometen 1618. in einer Harmonia stehe / was jhre praeludia gewesen / vnd was noch für Wunder in kürtzen ja jetzt werden offenbar werden. Autore *M. Paulo Nagelio.* Im Jahr MDCXIX. (The preface is dated " Argeliae 2. April. 1619." The first part of this work is called " Stellae Prodigiosae Seu Cometae per oculum triplicem observatio & explicatio. Das ist : Des newen Cometen vnd Wunder Sterns im October / November vnd December 1618. erschienen / warhafftige Deutung vnd Ausslegung per Magiam insignem, dergleichen zuvor nicht gesehen : Allen Menschen auff Erden zur guten Nachrichtung vnd Warnung fürgestellet Durch *M. Paulvm Nageli*' ML. M. Tehologum vnd Astronomum, &c. In Verlegung dess Autoris. Im Jahr 1619." These are two separate books with separate signatures, but they are bound together in the British Museum and the second is not catalogued. Only the second is relevant to the comet of 1577.)

Part II; *C.U.L.* 523.6 Z 1 (2) and *B.M.* 8563. aaa. 33 (16) and *C.D.H.* Part I; *B.M.* 8563. aaa. 33 (16).

Nepvev, Charles

See (69) Longus' " Traicté des Cometes..."

Neri, G. de'

77. Pronostico e discorso sopra la cometa apparsa il mese di Novembre l'anno 1577, con il giudicio dell' ecclisse. *Mantova, 1578.*

Houzeau 5613, not located.

Nolthius, A.

78. Observatio vnd Beschreibung des Cometen. *Erffurdt, 1578.*

Carl pp. 53-4 and *Struve*, not located.

Papeberg

See *Camerarius, Ioachimus.*

Planerius, Ioannes

79. *Ioannis Planerii* Qvintinai Brixiensis Artivm et Medicinae Doctoris Varia Opuscula :

Epistolae morales.
Patriae descriptio : in qua de animorum immortalitate.
Henrici Regis ad Vrbem Venetam aduentus.
De Comete, 1577.
De Lacte.

Cvm Privilegio. Venetiis, Apud Franciscum Zilettum. 1584.

C.D.H.

Praetorius, A[delardus] = Richter, A.

80. Erwarnung der Christianen uber die Gefahr des Cometen. *Erfurth, 1577.*

Houzeau 5604, not located.

Praetorius, Iacobus.

81. De Cometis, Qvi Antea Visi Svnt, Et De Eo, Qvi Novissime Mense Novembri Apparvit, narratio, scripta ad Amplissimvm Prvdentissimvmqve Reipvb. Noribergensis Senatvm, A *Iohanne Praetorio Ioachimico*, Reip. Noribergensis Astronomo, & Mathematum Professore in schola Altorfiana. Cum gratia & priuilegio Caesareae Maiestatis. Noribergae. cIↃ.IↃ.LXXVIII. *Imprimebatur Noribergae, in Officina Typographica : Catherinae Gerlachin, & Haeredum Iohannis Montani. M.D.LXXVIII.*

G.S. and *C.D.H.*

82. Narratio dern Cometen, so vor dieser Zeit sind gesehen worden, und dann auch dessen, der jüngst erschienen ist. *Nürnberg, 1578.*

Carl p. 54 and *Struve*, not located.

See (30) *Chytraeus*' " Vom Newen Stern... "

Pribicerus Jo.

83. Tractus de cometa anni 1577 *Novisolii, 1578.*

Carl p. 53, not located.

R. P.

84. Kurtzer Auszug aller Cometen, aus allen Authorn, so bis auff's 1578 jar von Cometen geschrieben haben,

zusammenbracht durch R. P. *Franckfurt a.M. 1578.*
Struve, I, 761, not located.

Raymundus, Hannibal

See (48) *Thaddaeus Hagecius ab Hayck:* " Descriptio cometae..."

See (14) and (15) *Bovius:* " Dechiaratione..." and " Trattato..."

85. Discovrs Sur la noble Comette apparue A Venise Av Mois De Nouembre 1577. la plus notable, gracieuse, & beneuole que l'on ait veu de nostre temps. Auec l'arc qui la procedoit à l'heure de son apparition, contenant les grands effets d'icelle. Fait en Italien par *M. Hannibal Raimondo* de Veronne, & depuis traduit en langue Françoise. A Lyon, Par Iean Patrasson. M.D.LXXVIII. Auec permission.
B.N. V 21091*bis* and *B.M.* 531. e. 28 (2).

86. Italian edition of " Discovrs Sur la noble Comette..."
The existence of the Italian edition is implied on the title page of the French edition.

Rasch, Jacobus

87. Cometen Buech. Von dem newen Stern des 73. vnnd von den Cometen des 77. vnnd 81. Jars / auch von allen anderen Cometen vnnd newen Stern erscheinungen / geschicklicher erforschung zu vrtheilen / wie die beschreibungen derselben / biedurch zuuerstehen sey / für den gemainen Mann so auff frembde wort vnd art von Astronomischem circelwerck zu reden / nit geübt / allen from̃en Christen zum trost vnd dieser zeit sehr notwendig zu wissen. Durch *Johann Rasch* / Burger zu Wien / Getruckt zu München / bey Adam Berg. Mit Röm: Rey: May: Freyheit nit nachzutrucken. (The dedication is dated " Wien den 6. January / Anno 1582.").
B.M. C. 71. h. 14 (9).

Raxus, Franciscus Fernandez

88. De Cometis, Et prodigiosis eorum portentis, libri quatuor. Ad Illustrissimum. D. D. Bernardum Martinez, de Bolea, Philippi, Hispaniarum Regis, secundi, vicecancellarium, atque Consiliarium: *Francisco Fernandez Raxo,* Aragoniensi Medico, autore. Cvm Privilegio Excudebat Madriti

Guillelmus Drouy, Typographus. Anno, 1578. (The introduction is by " Antonio de Erasso.")

C.D.H.

Reuchlin, E.

89. Epistel oder Sendebrieff von des 1577. Jares nach unsers wahren Messiae Jesu Christi geburt, Catastasi, Constitution oder Witterung, und daraus erfolgenden Kranckheiten. — *Lubeck, 1577.*

Houzeau 4930, not located.

La Rivière, R. L. de

90. Discours sur la signification de la comète apparue en Occident, au signe du Sagittaire, le 10 novembre. *Renne, 1577.*

Houzeau 5600, not located.

Richter, A.

See *Praetorius*, A.

Roccus, Angelus

91. Discorso Filosofico, Et Teologico Intorno Alle Comete. Oue si scuoprono molti secreti della Natura, con la dichiaratione de' Miracoli, & Portenti occorsi al Mondo. Del R. P. F. *Angelo Rocca* da Camerino Dott. Teologo dell' Ord. Agostiniano.

B.N. V 7952.

92. Discorso filosofico, teologico intorno alle comete, ove si scuoprono molti secreti della natura con la dichiaratione de' miracoli et portenti occorsi al mondo, nel occasione del cometa del 1577. *Venetiis, 1577.* (This item may very possibly be the same as the one above, but since the volume I saw in Paris does not give a date or place of publication or include the words " nel occasione del cometa del 1577," I prefer to list two separate items. The volume in the Bibliothèque Nationale deals at length with the comet of 1577.)

Houzeau, 5593, not located.

Roeslin, Helisaeus.

93. Theoria Nova Coelestivm *Μετεωρων*, In Qva Ex Plvrivm Cometarvm Phoenomenis Epilogisticῶs quaedam afferuntur, de novis tertiae cuiusdam Miraculorum Sphaerae Circulis, Polis & Axi : Svper Qvibvs Cometa Anni

M.D.LXXVII. nouo motu & regularissimo ad superioribus annis conspectam Stellam, tanquam ad Cynosuram progressus Harmoniam singularem vndiq; ad Mundi Cardines habuit, maximè verò medium Europae, & exactè Germaniae Horizontem non sine numine certo respexit. Authore *Helisaeo Roeslin*, Medico Tabernis Alsatiae. Argentorati. Excudebat Bernhardus Iobinus. M.D.LXXVIII.

C.D.H. and *B.N.* V 7960 and *B.M.* 522. e. 12 (1).

See (49) *Hagecius*' " epistola..."

Rothmannus, Christophorus

See (19) *Tycho Brahe*'s " T. B. Epistolarum..."

Santutius, Antonius

94. on the comet of 1577.

Implied by *Claramontius* in his " De Sede Svblvnari cometarvm...", not located.

Schinbain, J. G. (perhaps, *Tibianus, Johann Georg*)

95. Sternen oder Cometen Buch. *Ingolstatt, 1578.*

Struve, I, 761, not located.

Scultetus, Bartholemaeus

96. Cometae, Anno Hvmanitatis I.C. cIↃ.IↃ.LXX.VII. à 10. VIIIIbris per Xbrem in 13. Januarij sequentis anni, continuis Lx. & V, D. in sublunari regione adparentis, Descriptio. De illius motu Visibili et vero, adiectis cognitu dignioribus calculi, tabularum & demonstrationum ocularium fundamentis. Denique de huius meteoricae impressionis Significatione, ex praemissa descriptione, concepta. Authore *Bartolemaeo Scvlteto* Philomathe. *Gorlicii Excudebat Ambrosius Fritsch, Anno 1578.*

B.M. 8610. b. 60.

97. Des grossen und wunderbaren Cometen u.s.w. Astronomische und natürliche Beschreibung. *Görlitz, 1578.*

Carl p. 54 and *Struve, I,* 787, not located.

Selneccerus, N.

98. Notwendiger Christlicher Bericht von dem Cometen. *Leipzig, 1577.*

Carl p. 53, not located.

99. Erwartung an den Christianen nöthig über den Cometen. *Leipzig, 1577.*

Houzeau 5603, not located.

Sorbolus, Girolamus

100. Dialogo In Materia Delle Comete, Del Sig. *Girolamo Sorboli* Dottore di Filosofia, et Medicina. In Ferrara, M.D.LXXVIII. Per Vittorio Baldini, Con licenza de i Superiori.

C.D.H. and *B.N.* V 7957.

Sordis, Petrus

101. Discorso Sopra Le Comete, Di Pietro Sordi. Alla Ill^ma^. Sig^ra^. La Sig.^ra^ Barbara Sanseverina, Contessa Di Sala. In Parma, Appresso Seth Vioto. 1578. Con licenza de' Superiori.

C.D.H.

Squarcialupus, Marcellus

See (37) *Erastus*' " De Cometis..."

Steinmetz, Valentinus

102. Von dem Cometen welcher im Nouember des 1577. Jars erstlich erschinen / vnd noch am Himmel zusehen ist / wie er von Abend vnd Mittag / gegen Morgen vnd Mitternacht zu / seinen fortgang gehabt / obseruirt vnd beschriben in Leiptzig. *Gedruckt zu Augspurg / durch Michael Manger.* (The dedication is signed " *M. Valen. Steinmetz* / Gersbach :").

C.D.H.

103. Von dem Cometen welcher im Nouember des 1577. Jars erstlich erschienen / vnd noch am Himmel zusehen ist / wie er von Abend vnd Mittag gegen Morgen vnd Mitternacht zu / seinen fortgang gehabt / obseruirt vnd beschrieben in Leipzig. *Bedruckt zu Leiptzig / bey Nickel Nerlich Formschneider.* (The dedication is signed " *M. Valen. Steinmetz* / Gersbach.")

C.D.H. and *N.Y.P.L.* *KB 1577 and *B.M.* 8560. cc. 1.

Thurneyserus, Leonardus

104. Discorso Natvrale Sopra xiij. Nouilunij dell' anno M.D.LXXXI. Calcvlato Per L'Eccell. Dottore, il Sig. *Leonardo Thurneijssero* Astrologo, & Medico del Brandeburg Elettor dell' Imperio. Tradotto di lingua Tedesca nella nostra Italiana. Con vn Trattato delle Comete. Cō Priuilegio Della Ces. Maestà. *In Ferrara Per Vittorio Baldini, Con licenza de' Superiori.*

B.N. V 1210 Inv. Réserve.

105. Kurtze Geschichte der Cometen 136 vnd 1577. *Berlin, 1577.*

Carl p. 53. The existence of a German edition is implied on the title page of the Italian edition. Not located.

Vigenère, Blaise de

106. Traicté Des Cometes, Ov Estoilles Chevelves, Apparoissantes Extraordinairement au ciel : Auec leurs causes & effects. Par *Bl. de Vige*re. A Paris, Chez Nicolas Chesneau, rue sainct Iacques, au Chesne verd. M.D.LXXVIII. Avec Privilege Dv Roy.

C.D.H. and *B.N.* V_3 1636, V 1660 and V 21089.

107. Traicté Des Cometes, Ov Excroissance De Lvmiere Apparoissant ès estoilles. *Par Bl. de Vig*re. A Paris, Chez Nicolas Chesneau, rue sainct Iacques, au Chesne verd. M.D.LXXVII. Avec Privilege Dv Roy.

C.D.H. has title page only. Is there a book?

William IV, (Landgrave of Hesse Cassel)

See (19) *Tycho Brahe*'s " T. B. Epistolarum..."

108. Coeli et siderum in eo errantium observationes Hassiacae,.. *Principis Wilhelmi...* auspiciis quondam (partim ab ipsomet... partim ab ipsius mathematicis) institutae. Et specilegium biennale, ex observationibus Bohemicis... *Tychonis Brahe.* Nunc primum publicante *W. Snellio.* R. F. Quibus accesserunt *J. Regiomontani* et *B. Walteri* observationes Noribergicae. 2 *pt. Lugduni Batavorum, 1618.*

B.M. 531. k. 13 (1), located but not consulted.

Wincklerus, Nicolaus

109. Cometa Pogonias, Qvi Anno Labente 1577. Mense Novembri Et Decembri Apparvit, Demonstratus vnà cum parallaxi, distantia à Centro terrae, & significatione eius. Avtore *D. Nicolao Vuincklero,* Halae Sueuorum Physico. Cum gratia & Priuilegio Caesareae Maiestatis, ad annos Sex. Noribergae. cIↃ.IↃ.LXXVIII. *Executebatur Noribergae, in Officina Typographica Catherinae Gerlachin, & Haeredum Iohannis Montani. M.D.LXXVIII.*

C.D.H. and *B.M.* 532. e. 60.

Woldstedt, Fredericus

110. De Gradu Praecisionis Positionum Cometae Anni Millesimi Quingentesimi Septuagesimi Septimi A Celeberrimo *Tychone Brahe* Per Distantias A Stellis Fixis Mensuratas Determinatarum Et De Fide Elementorum Orbitae Quae Ex Illis Positionibus Deduci Possunt, Specimen Academicum Quod Venia Amplissimi Ordinis Philosophorum Ad Imp. Alexand. In Fennia Univ. Praeside Nathan. Gerhardo Af Schultén Phil. Doctore, Mathem. Professore Publ. et Ord., Ordd. Imp. Reg. de S:to Stanislao in secunda et Imp. de S:to Wladimiro in quarta Classe Equite, &c. Pro Gradu Philosophiae Doctoris Obtinendo Publico Examini Modeste Subjecit *Fridericus Woldstedt* Philosophiae Licentiatus In Auditorio Philos. Die VIII Junii MDCCCXLIV. H.A.M.S. Helsingforsiae Ex Officina Typographica Frenckelliana.

C.U.L. 523.6 Z 17 Q (3).

Zeissius, Matthaeus

111. Beschreibung der Cometen, besonders dess von 1577. *Franckfurt a. d. Oder, 1578.*

Carl p. 53, not located.

Although I have found no reference to specific works by the following men, dealing with the comet of 1577, I believe that they might possibly have written such tracts or treatises. Therefore I offer their names as possible clues to works not included in my bibliography.

a) QUINTUS GEORGIUS, who is mentioned in (37) ERASTUS' " De Cometis..." on the verso of C_3.

b) ANTOINE MIZAULD or MIZALDUS, who lived from 1520 to 1578 and who wrote on comets during the first half of the century. He is mentioned in (37) ERASTUS' " De Cometis..." on the verso of E_3.

c) J. PADUANIUS, who according to page 535 of the second volume of STRUVE's catalogue (*Struve, II*, 535) wrote a work entitled " Opus de stellis " which was printed in Verona in 1578.

d) GASPARD (or CARPARUS) PEUCER (or PEUCERUS), a mathematician and astronomer who lived from 1525 to 1602, to whom, according to the British Museum catalogue, TYCHO BRAHE wrote

a letter, and who is mentioned in (37) ERASTUS' " De Cometis..." on the verso of B_3 and the recto of B_4. Since the first proof of this article was printed, a 1595 manuscript copy of a letter from TYCHO BRAHE to PEUCER dated September 13, 1588, and the latter's answer dated May 10, 1589, has come into the possession of *C.D.H.*

e) R. P. PHILOMATHESIUS, who is mentioned in (37) ERASTUS' " De Cometis..." on the verso of C_3.

f) JOSEPH JUSTUS SCALIGER, who lived from 1540 to 1609, and might have been disposed to write on the comet of 1577.

(New York City.) C. DORIS HELLMAN.

Ueber Leibnizens Methode der direkten Differentiation

Beitrag zur Geschichte der Differentialrechnung

I.

In der heutigen Differentialrechnung wird, wie bekannt, das Differential einer Funktion vermittels ihrer Ableitung bestimmt. Es wäre aber nicht unmöglich, den Versuch einer direkten Bestimmung des Differentials zu machen, vermittels der Formel für die Differenz einer Funktion. (1) Zweck dieser Abhandlung ist

(1) Nach der ersten Methode, der Methode der indirekten Differentialbestimmung, ist die Bestimmung der Ableitung die primäre und diejenige des Differentials die sekundäre Operation der Differentialrechnung. Die Ableitung wird darin durch die Formel:

$$\frac{dy}{dx} = \lim_{\Delta x = o} \frac{\Delta f(x)}{\Delta x} = \lim_{h = o} \frac{f(x+h) - f(x)}{h} = f'(x)$$

und das Differential durch die Formel:

$$dy = f'(x)\,dx$$

definiert.

Nach der zweiten Methode dagegen, der Methode der direkten Differentiation, stellt die Bestimmung des Differentials die primäre und diejenige der Ableitung die sekundäre Operation dar. Das Differential ist in derselben durch die Formel:

$$d f(x) = \lim_{\Delta x = dx} \Delta f(x) = \lim [f(x + \Delta x) - f(x)]$$

und die Ableitung durch die Formel:

$$\frac{d f(x)}{dx} = \frac{\lim \Delta f(x)}{\lim \Delta x} \text{ (für } \Delta x = dx)$$

zu definieren, wobei Differentiale als Infinitesimalgrössen aufzufassen sind.

Während nach der ersten Methode der Differentialquotient nur ein Symbol für den Grenzwerth des Differenzenquotienten sein soll (d.h. $\frac{dy}{dx} = \lim \frac{\Delta f(x)}{\Delta x}$), stellt er nach der zweiten Methode den ächten Quotienten der Differentiale $df(x)$ und dx dar.

es zu zeigen, dass der Hauptentdecker der Infinitesimalrechnung, LEIBNIZ selbst, (2) zu den in der ersten von ihm über diese Rechnung publicierten Abhandlung (3) ohne Beweis mitgetheilten Grundformeln der Differentialrechnung vermittels der Methode der direkten Differentiation gelangt ist. Freilich hat er diese Methode nirgends explicite so formuliert wie wir sie in der ersten Anmerkung hier in der modernen mathematischen Zeichensprache formuliert haben, er wendet sie aber thatsächlich an.

2

Dass LEIBNIZ thatsächlich die Methode der direkten Differentiation zur Gewinnung der in seiner ersten Abhandlung ohne Beweis mitgetheilten Grundformeln der Differentialrechnung benutzt hat, für diese Behauptung lassen sich die folgenden vier Gründe anführen :

1. Alle diese Formeln (die LEIBNIZ als „regulae calculi differentialis" bezeichnet) beziehen sich auf Differentiale;

2. Man kann sie alle durch direkte Differentiation ableiten;

3. Den die Tangente einer Kurve bestimmenden Differentialquotienten fasst LEIBNIZ als ächten Quotienten der Differentiale *(dy* und *dx)* auf;

4. In seinem letzten vor der Publikation seiner Abhandlung

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(2) Dass LEIBNIZ im Vergleich mit NEWTON und BARROW als Hauptentdecker der Infinitesimalrechnung zu gelten hat, müsste freilich besonders bewiesen werden. Ueber den Unterschied zwischen dem Haupt-, dem Nebenentdecker und dem Vorgänger einer wissenschaftlichen Theorie vergleiche man die Ausführungen des Verfassers in seiner Studie : N. LOBATSCHEWSKY et J. BOLAYI, Étude comparative d'un cas spécial d'inventeurs simultanés, erschienen in *Revue philosophique*, sept.-oct. 1929 (p. 190-191). Man vergleiche auch seine Bemerkungen darüber in dem Aufsatze : *Charles Darwin und Alfred Russel Wallace*, Beitrag zur höheren Psychologie und zur Wissenschaftsgeschichte, erschienen in "*Isis*," vol. VII, 1, 1925 (S. 25).

(3) Diese Abhandlung trägt den Titel : *Nova methodus pro maximis et minimis, itemque tangentibus, quae nec fractas, nec irrationales quantitates moratur, et singulare pro illis calculi genus* " und ist in " *Acta Eruditorum*," Lipsiae 1684 erschienen. Dieselbe wurde in *Leibnizens mathematischen Schriften*, hgb. v. C. L. GERHARDT, Bd. V, 1858, S. 220-226, wiederabgedruckt und in deutscher Uebersetzung (in LEIBNIZ, Ueber die Analysis des Unendlichen, hgb. v. G. KOWALEWSKI) in der Sammlung Ostwalds Klassiker der exakten Wissenschaften N° 162 (S. 3-11) neben anderen Abhandlungen von LEINBIZ publiciert. Wir werden sie in folgendem nach der Ausgabe von GERHARDT citieren.

an NEWTON (durch OLDENBURG) gerichteten Briefe aus dem Jahre 1677, in einer einige Jahre später publicierten Abhandlung, sowie in seinen von GERHARDT im XIX-en Jahrhundert publicierten Manuskripten sind fast alle diese Grundformeln ausdrücklich nach der Methode der direkten Differentiation abgeleitet.

Die drei ersten Beweisgründe würden uns nur zur Aufstellung einer wahrscheinlichen historischen Hypothese berechtigen; der vierte erhebt aber diese Hypothese zur unzweifelhaften historischen Wahrheit. Wir wollen nunmehr diese Beweisgründe näher darlegen.

Die in *Nova Methodus* von LEIBNIZ ohne Beweis mitgetheilten Grundformeln sind die folgenden: 1) $da = 0$; 2) $dax = adx$; 3) $d(z - y + w + x) = dz - dy + dw + dx$; 4) $dxv = xdv + vdx$; 5) $d\frac{v}{y} = \frac{\pm vdy \mp ydv}{yy}$; 6) $dx^a = ax^{a-1}dx$; 7) $d\frac{1}{x^a} = -\frac{adx}{x^{a+1}}$; 8) $d\sqrt[b]{x^a} = dx\frac{a}{b}\sqrt[b]{x^{a-b}}$ und 9) $d\frac{1}{\sqrt[b]{x^a}} = \frac{-adx}{b\sqrt[b]{x^{a+b}}}$.

Man kann leicht zeigen, dass alle diese Formeln durch direkte Differentiation ableitbar sind. (4)

Dass für LEIBNIZ der Differentialquotient einen ächten Quotienten der Differentiale darstellt, folgt aus seiner Behauptung wonach dy das vierte Glied einer Proportion sein soll, in der die zwei ersten Glieder die Subtangente und die Ordinate sind und das dritte dx. (5)

(4) So lässt sich die Produktformel $dxy = xdy + ydx$ in folgender Weise ableiten. Durch Anwendung der Formel $\Delta f(x) = f(x + \Delta x) - f(x)$ folgt:

$$\Delta(xy) = (x + \Delta x)(y + \Delta y) - xy = y\Delta x + x\Delta y + \Delta x\Delta y,$$

und hieraus (da $dxdy$ als unendlich kleine Grösse zweiter Ordnung zu veranlässigen ist):

$$dxy = ydx + xdy.$$

In ähnlicher Weise folgt:

$$\Delta\left(\frac{x}{y}\right) = \frac{x + \Delta x}{y + \Delta y} - \frac{x}{y} = \frac{y\Delta x - x\Delta y}{y^2 + y\Delta y},$$

voraus:

$$d\left(\frac{x}{y}\right) = \frac{ydx - xdy}{y^2}.$$

U. s. w.

(5) Die Ueberlegenheit seiner Methode den früheren gegenüber hervorhebend sagt LEIBNIZ: "Editae vero hactenus methodi talem transitum non habent,

In seinem an NEWTON im Jahre 1677 gerichteten Briefe leitet LEIBNIZ ausdrücklich die Formel $dy^2 = 2ydy$ durch direkte Differentiation ab und bemerkt, dass in derselben Weise auch die Formeln für dxy und dxy^2 ableitbar sind. (6) In demselben Briefe führt dann LEIBNIZ weiter das Beispiel einer implicit:n Funktion an, deren Differentialquotienten er bestimmt indem er sie zunächst durch die implicite Anwendung der Formel $\Delta f(x, y) = f(x + \Delta x, y + \Delta y) - f(x, y)$ direkt differentiert. (7)

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adhibent enim plerumque rectam ut DX, vel aliam huiusmodi, non vero rectam dy, quae ipsis DX, DY, dx est quarta proportionalis, quod omnia turbat" (*Nova Methodus, l.c.*, S. 223 und fig. 111; vgl. auch Ostwalds Klassiker N° 162, S. 7 und fig. 1; die diesbezügliche Figur Leibnizens ist hier in der Beilage als Fig. 1 reproduciert).

In seinem an NEWTON 1677 gerichteten Briefe ist eine Figur Leibnizens vorhanden in der die Proportionalität von dx und dy (nicht von dy und dx) mit der Ordinate und Subtangente noch deutlicher zum Vorschein kommt (diese Figur ist hier in der Beilage als Fig. 2 reproduciert).

(6) " Nam sint duae proxime sibi (id est differentiam habentes infinite parvam) scilicet y et $y + d\bar{y}$, quoniam ponimus $d\bar{y}^2$ esse differentiam quadratorum ab his duabus, ejus valor eret $y^2 + 2\,ydy + d\bar{y}^2 - y^2$, seu omissis $y^2 - y^2$, quae se destruunt, item omisso quadrato quantitatis infinitae parvae, et... erit $d\bar{y}^2$ *Π* $2ydy$, itemque est de ceteris potentiis. Hinc etiam haberi possunt differentiae quantitatum ex diversis indefinitis in se invicem ductis factarum, ut : $d\bar{y}\bar{x}$ erit *Π* $ydx + xdy$ et $d\bar{y}^2\bar{x} = 2\,xdy + y^2d\bar{x}$." (LEIBNIZENS mathematische Schriften, hgb. v. C. L. GERHARDT, Bd. I, Brief XLII, LEIBNIZ an OLDENBUKG, S. 154),

Wie man sieht, setzt LEIBNIZ in diesem Briefe in dy und dx einen horizontalen Strich über y und x, um Differentiale von den Produkten unterscheiden zu können; bereits in "*Nova Methodus*" that er das nicht mehr. Sowohl in diesem Briefe wie später werden die Zeichen dy und dx sowohl für die Differentiale wie für die endlichen Differenzen gebraucht.

(7) Es ist die Funktion $a + by + cx + dyx + ey^2 + fx^2 + gy^2x + hyx^2 = o$. An das Zitat der vorigen Anmerkung direkt anschliessend fährt LEIBNIZ fort : " Hinc si sit aequatio

$a + by + cx + dyx + ey^2 + fx^2 + gy^2x + hyx^2$, etc. *Π* o,

statim habetur tangens curvae ad quam est ista aequatio. Nam... in aequatione illa substituendo $y + d\bar{y}$ et $x + d\bar{x}$ fiet :

$a + by + cx + dyx + ey^2 + fx^2 + gy^2x + hyx^2$, etc.

$$\begin{array}{l} + bd\bar{y} + cd\bar{x} + dyd\bar{x} + 2\,eyd\bar{y} + 2\,fxdx + 2\,gxyd\bar{y} + 2\,xhyd\bar{x} \\ \qquad\quad + dxd\bar{y} \qquad\qquad\qquad\quad + gy^2d\bar{x} + hx^2d\bar{y} \end{array} \quad \Pi o$$

$$+ dd\bar{x}d\bar{y} + ed\bar{y}|^2 + fd\bar{x}|^2 + gd\bar{y}|^2x + hd\bar{x}|^2y + 2\,gyd\bar{y}d\bar{x} + 2\,hxd\bar{x}d\bar{y}$$

ubi abjectis illis quae sunt supra primam lineam quippe nihilo aequalibus per aequationem praecedentem, et abjectis illis quae sunt infra secundam, quia in illis duae indefinitae parvae in se invicem ducuntur, hinc restabit tantum aequatio haec :

In der um das Jahr 1700 publicierten Abhandlung „*Symbolismus memorabilis*" (8) wird von LEIBNIZ die Produktformel $dxy = ydx + xdy$ ebenfalls durch direkte Differentiation abgeleitet. (9)

$bd\bar{y} + cd\bar{x} + \frac{bydx}{bxd\bar{y}}$ etc. *Ito*, quicquid scilicet reperitur inter lineam primam et secundam, et... fiet

$$-\frac{d\bar{y}}{d\bar{x}}\ \Pi\ \frac{c + dy + 2\,dfx + gy^2 + 2\,hxy \text{ etc.}}{b + dx + 2\,ey + 2\,gxy + hx^2 \text{ etc.}}$$

id est $\left(\text{quia } \frac{-d\bar{y}}{d\bar{x}} \text{ seu } \frac{-{}_1B_2\,B \text{ seu } -{}_1CD}{D_2C}\ \Pi\ \frac{-T_1B}{{}_1B_1C}\right)$

erit $\frac{c + dy \text{ etc.}}{b + dx \text{ etc.}}\ \Pi\ \frac{-T_1B}{{}_1B_1C}$. (a.a.O., S. 154-155 und fig. 27, die hier in der Beilage als Fig. 2 reproduciert ist).

Das komplicierte Beispiel, welches LEIBNIZ zur Ausrechnung des Differentialquotienten in *Nova Methodus* (" ut modus superioribus regulis in calculo etiam difficiliore utendi appareret ") anführt (*l.c.*, S. 223), ist wiederum eine implicite Funktion, ihr Differentialquotient wird aber nicht wie oben durch direkte Differentiation sondern durch die Anwendung der Grundformeln abgeleitet.

Es soll nicht unerwähnt bleiben, dass MORITZ CANTOR in seinen verdienstvollen " Vorlesungen über Geschichte der Mathematik," Bd. III, 2-te Aufl. S. 187-188 zwar den Inhalt der beiden angeführten Stellen aus LEIBNIZens Briefe an NEWTON im Auszug (zum Beweise der Unabhängigkeit Leibnizens) bringt, dass er aber weder an dieser Stelle noch anderswo in seinem Werke das Specifische der Leibnizischen Differentialmethode hervorhebt.

(8) Der volle Titel der betreffenden Abhandlung lautet : *Symbolismus memorabilis calculi algebraici et infinitesimalis in comparatione potentiarum et differentiarum, et de lege homogeneorum transcendentali*. Dieselbe erschien in " *Miscellanea Berolinensis* " und wurde von GERHARDT in *Leibnizens mathematische Schriften*, Bd. V, S. 377-382 (ohne Angabe der ursprünglichen Jahreszahl) wiederabgedruckt, sowie von KOWALEWSKI in deutscher Uebersetzung in Ostwalds Klassiker, N° 162, S. 65-71.

(9) Nachdem er die allgemeine Binomialformel angeführt, fährt LEIBNIZ fort : " Veniamus jam ad differentiationes... Primum ergo $d(xy) = ydx + xdy$, ut olim docuimus, cum primum multis abhinc annis calculum differentialem proponeremus, ex quo uno fundamento totus reliquus differentiarum calculus demonstrari potest. Ipsum autem fundamentum hic sic ostenditur : $d(xy)$ est differentia inter $(x + dx)\,(y + dy)$ et xy,... Est autem $(x + dx)\,(y + dy) = xy + ydx + xdy + dxdy$ unde si auferas xy, fit $ydx + xdy + dxdy$; sed quia dx vel dy est incomparabiliter minus quam x et y, etiam $dxdy$ erit incomparabiliter minor quam xdy et ydx, ideoque rejicitur, tandemque fiet $(y + dx)\,(y + dy) - xy = ydx + xdy$ (vgl. " *Symbolismus memorabilis*," a.a.O. S. 379 und Ostwalds Klassiker, N° 162, S. 67).

Aus diesem Zitat ersieht man, dass LEIBNIZ mehrere Jahre nach der Publikation seiner ersten Abhandlung eine von deren Grundformeln (die er hier für so grundlegend erklärt, dass aus ihr " totus reliquus differentiarum calculus demonstrari potest ") noch immer durch direkte Differentiation ableitet. Es kann also kein Zweifel darüber obwalten, dass er auch alle übrigen Grundformen seiner ersten Abhandlung auf gleichem Wege erhalten hat.

Und schliesslich findet man in den von GERHARDT herausgegebenen Manuskripten noch manche von den neun Grundformeln durch direkte Differentiation abgeleitet. (10)

3

Die Frage, ob die Methode der direkten Differentiation logisch haltbar oder unhaltbar sei (11), ist völlig unabhängig von der rein historischen Frage, ob sich LEIBNIZ bei der Ableitung der ersten in den Grundformeln der *Nova Methodus* vorkommenden Differentiale (12) ihrer bedient habe oder nicht. Während diese

(10) Diese Manuscripte wurden unlängst in englischer Uebersetzung von J. M. CHILD herausgegeben unter dem Titel : *The Early mathematical manuscripts of Leibniz*, Chicago-London, 1920.

In einem von ihnen (undated manuscript, circa 1680) findet man das Differential von $\frac{y}{x}$ durch direkte Differentiation folgendermaassen abgeleitet :

" Here we have

$$d\frac{y}{x} = \frac{xdy - ydx}{xx}.$$

For $d\frac{y}{x} = \frac{y + dy}{x + dx} - \frac{y}{x} = \frac{xdy - ydx}{xx + xdx}$, which becomes (if we write xx for $xx + xdx$, since xdx can be omitted as being infinitely small in comparison with xx) equal to $\frac{xdy - ydx}{xz}$ (*l.c.*, p. 143).

(11) In der That ist sie mit logischen Schwierigkeiten behaftet, die sich schwerlich werden beheben lassen.

Erstens leidet dieselbe an der allgemeinen Schwierigkeit, dass in ihr die Erweiterung des Begriffs der Grenze (vgl. Anmerkung 1) mit dem Princip der (relativen) Vernachlässigung unendlich kleiner Grössen verknüpft werden muss (vgl. Anm. 6).

Und zweitens treten specielle Schwierigkeiten auf, wenn man dieselbe auf transcendente Funktionen anwenden will (während sie von LEIBNIZ in " *Nova Methodus* " nur auf algebraische Ausdrücke angewandt wurde). So müsste bei der Ableitung des Differentials von $\sin x$ ($d \sin x = \lim \Delta \sin x = \lim [\sin (x + \Delta x) - \sin x] = \lim (\sin x \cos \Delta x) + \lim (\cos x \sin \Delta x) - \sin x = \cos x$) einerseits (in $\sin x \cos dx$) $dx = o$ und anderseits (in $\cos x \sin dx$) $\sin dx = dx$ gesetzt werden. Noch grössere Schwierigkeiten treten bei der logarithmischen Funktion auf u.s.w.

In dem bekannten Werke von L. CARNOT, Réflexions sur la Métaphysique du calcul infinitésimal, 1797 (welches in der Kollektion Les Maîtres de la pensée scientifique in zwei Bändchen 1921 wiederabgedruckt wurde) findet sich der Versuch, auch trigonometrische und logarithmisch-exponentiale Funktionen durch direkte Differentiation abzuleiten (t. I, p. 62-63 und p. 70-72 in der Neuauflage). Soviel dem Verfasser dieser Abhandlung bekannt, ist L. CARNOT der einzige Mathematiker der den Versuch gemacht hat, die Methode der direkten Differentiation zur logischen Basis der Differentialrechnung zu erheben.

(12) Bekanntlich hat LEIBNIZ als erster auch die höheren Differentiale in die

Methode heutzutage entweder gar nicht oder ganz vereinzelt und aus rein didaktischen Gründen benutzt wird, war sie, wie sich dies aus unseren Ausführungen unzweifelhaft ergibt, für LEIBNIZ selbst bei der Erfindung seiner Differentialrechnung von grundlegender und ausschliesslicher Bedeutung. (13)

BRAANISLAV PETRONIEVICS.

Differentialrechnung eingeführt. Deren Begriff kommt schon in "*Nova methodus*" vor (wo sie LEIBNIZ zur Bestimmung von Konkavität und Konvexität und von Wendepunkten verwendet), aber erst in "*Symbolismus memorabilis*" kommt die bekannte allgemeine Formel für $d^n(xyz...)$ vor.

(13) Auch in dem ersten Lehrbuch der Differentialrechnung, in der 1696 publicierten Analyse des Infiniment Petits des Marquis DE L'HOSPITAL, werden die ersten Differentiale vermittels der direkten Differentiation abgeleitet (in CANTOR's Vorlesungen, Bd. III, S. 245 werden Beispiele aus DE L'HOSPITAL angeführt, an denen das zu ersehen ist). Dasselbe geschieht in der unlängst (1924) in deutscher Uebersetzung von P. SCHAFHEITLIN herausgegebenen Differentialrechnung von J. BERNOULLI (Ostwalds Klassiker, N° 211), einer Schrift deren ursprüngliches Manuscript nach Herausgeber aus den Jahren 1691 /2 stammen und die Marquis DE L'HOSPITAL bei der Abfassung seines Buches benutzt haben soll (a.a.O., Vorwort, S. 1-10).

BEILAGE

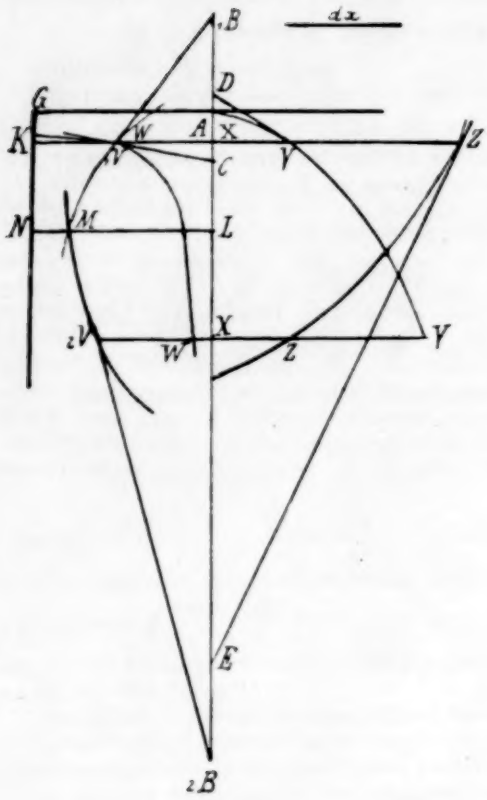


FIG. 1

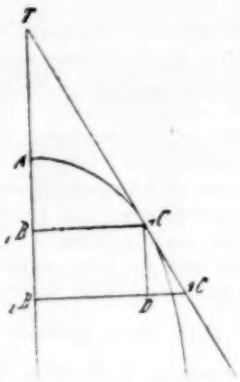


FIG. 2

FIG. 1. — In dieser Figur stellt AX die Abscissenaxe dar, VX (resp. ${}_1VX$, ${}_2VX$), WX, YX, ZX sind die Ordinaten der Kurven VV, WW, YY, ZZ und VB, WC, YD, ZE deren Tangenten.

Dies ist die erste der drei Figuren in Leibnizens Abhandlung "*Nova Methodus*," erschienen in Acta Eruditorum, 1684.

FIG. 2. — In dieser Figur stellt T_1C die Tangente der Kurve A_1C im Punkte ${}_1C$, T_1B ist die Subtangente und ${}_1B_1C$ die Ordinate, ${}_1B_2B = D_1C = dy$, $D_2C = dx$.

Dies ist die erste der in dem Briefe Leibnizens an NEWTON aus dem Jahre 1677 enthaltenen Figuren.

George Catlin

"Indian-loving Catlin"

(1796-1872)

CATLIN's name is not so popular to-day as it was some fifty years ago when his books were found in a great many homes, being read not only in English but also in French and German, and when his collection of Indian paintings—finally presented to the United States by Mrs. HARRISON in 1879—was the main attraction of the National Museum of Washington. His publications on Indian life and customs have been superseded by better ones, and there is now little reason except for professional ethnologists to refer to them, unless one be especially interested in the man himself and his immortal achievements. Indeed, he was one of the pioneers of American anthropology, and the value of his written and graphical testimonies concerning as they do conditions which have long ceased to exist, cannot be overestimated.

The man was a great man, who has not yet received his full reward. For instance, we have not yet any satisfactory biography, though we owe THOMAS DONALDSON, an abundance of documents concerning him, published in 1886.

The brief account which I shall give presently is largely derived from DONALDSON, but let us first listen to CATLIN himself. The latter was reticent about certain matters, for instance, it is not always easy to reconstruct his itineraries, not to speak of his "curriculum vitae," from the little he chose to impart to his readers; yet we find some interesting confidences at the beginning of his most important and best known work, the "Letters and notes on the manners, customs and condition of the North American Indians. (1) Says he (in letter one):

(1) I quote from the first American edition (2 vols., New York, 1841). The text is exactly the same in the tenth edition (London, 1866).

" Leaving my readers... to find out what is in the book, without promising them anything, I proceed to say—of *myself*, that I was born in Wyŏming, in North America, some thirty or forty years since, of parents who entered that beautiful and famed valley soon after the close of the revolutionary war, and the disastrous event of the ' Indian massacre.'

" The early part of my life was whiled away, apparently, somewhat in vain, with books reluctantly held in one hand, and a rifle or fishing-pole firmly and affectionately grasped in the other.

" At the urgent request of my father, who was a practising lawyer, I was prevailed upon to abandon these favourite themes, and also my occasional dabblings with the brush, which had secured already a corner in my affections; and I commenced reading the law for a profession, under the direction of REEVE and GOULD, of Connecticut. I attended the lectures of these learned judges for two years—was admitted to the bar—and practised the law, as a sort of *Nimrodical* lawyer, in my native land, for the term of two or three years; when I very deliberately sold my law library and all (save my rifle and fishing-tackle), and converting their proceeds into brushes and paint pots; I commenced the art of painting in Philadelphia, without teacher or adviser.

" I there closely applied my hand to the labours of the art for several years; during which time my mind was continually reaching for some branch or enterprise of the art, on which to devote a whole life-time of enthusiasm; when a delegation of some ten or fifteen noble and dignified-looking Indians, from the wilds of the ' Far West,' suddenly arrived in the city, arrayed and equipped in all their classic beauty,—with shield and helmet,—with tunic and manteau,—tinted and tasselled off, exactly for the painter's palette !

" In silent and stoic dignity, these lords of the forest strutted about the city for a few days, wrapped in their pictured robes, with their brows plumed with the quills of the war-eagle, attracting the gaze and admiration of all who beheld them. After this, they took their leave for Washington City, and I was left to reflect and regret, which I did long and deeply, until I came to the following deductions and conclusions.

" Black and blue cloth and civilization are destined, not only to veil, but to obliterate the grace and beauty of Nature. Man, in the simplicity and loftiness of his nature, unrestrained and unfettered by the disguises of art, is surely the most beautiful model for the painter,—and the country from which he hails is unquestionably the best study or school of the arts in the world : such I am sure, from the models I have seen, is the wilderness of North America. And the history and customs of such a people, preserved by pictorial illustrations, are themes worthy the life-time of one man, and nothing short of the loss of my life, shall prevent me from visiting their country, and of becoming their historian."..

" With these views firmly fixed—armed, equipped, and supplied, I started out in the year 1832, and penetrated the vast and pathless wilds which are familiarly denominated the great ' Far West ' of the North American Continent, with a light heart, inspired with an enthusiastic hope and reliance that I could meet and overcome all the hazards and privations of a life devoted to the production of a literal and graphic delineation of the living manners, customs, and character of an interesting race of people, who are rapidly passing away from the face of the earth—lending a hand to a dying nation, who have no historians or biographers of their own to pourtray with fidelity their native looks and history; thus snatching from a hasty oblivion what could be saved for the benefit of posterity, and per-

petuating it, as a fair and just monument, to the memory of a truly lofty and noble race.

"I have spent about eight years already in the pursuit above-named, having been for the most of that time immersed in the Indian country, mingling with red men, and identifying myself with them as much as possible, in their games and amusements; in order the better to familiarize myself with their superstitions and mysteries, which are the keys to Indian life and character."

However vague these extracts may be with regard to the biographical facts, it tells us the essential: the gradual definition of the great purpose to which CATLIN's life was devoted. Indeed is not that the main thing in any man's life? We might almost divide all men and women into two groups: those who have anchored themselves so-to-say on some great undertaking, on some great inspiration, on some great duty,—and those far more numerous who have no other guidance than material needs and common obligations. However unsuccessful the former may seem to be, if they have been faithful to their ideal, they have raised themselves to a higher level; however successful the latter may seem to be, their lives were nothing but failures: *Receperunt mercedem suam, vani vanam.*

To return to CATLIN, he was born on July 26, 1796 in Wilkes-Barré, (2) in the Wyoming Valley of Pennsylvania. At the time of the Revolutionary War his grandfather, ELI CATLIN, and his father, PUTNAM CATLIN, had enlisted together (Jan. 1777) in the same company of the Second Connecticut Regiment; they finally came out ELI a captain, and PUTNAM fife major. After the war, PUTNAM read law and settled in 1787 at Wilkes-Barré. In 1789, he married POLLY SUTTON and they had fourteen children, GEORGE being fifth.

"POLLY was the daughter of early settlers of Wyoming Valley, then known as 'Wyoming settlers,' and was born at Exeter, Luzerne County, Pa., September 30, 1770. Her father was one of the settlers engaged in the battles with the Indians at the famous massacre of July, 1778, and she, along with her mother, was captured by the Indians at the surrender of Forty Fort. They were afterwards released.

"She was a playmate of FRANCES SLOCUM, the girl of five years of age who was taken prisoner and carried off by the Indians and found fifty-nine years afterwards near Logansport, Ind., living with and adopted by the Miami Indians. Her portrait showed her to have been a woman of personal beauty and determination. She was a woman of fine artistic taste, and from her GEORGE undoub-

(2) Now Wilkesbarre on the Susquehanna River, about 120 miles from Philadelphia.

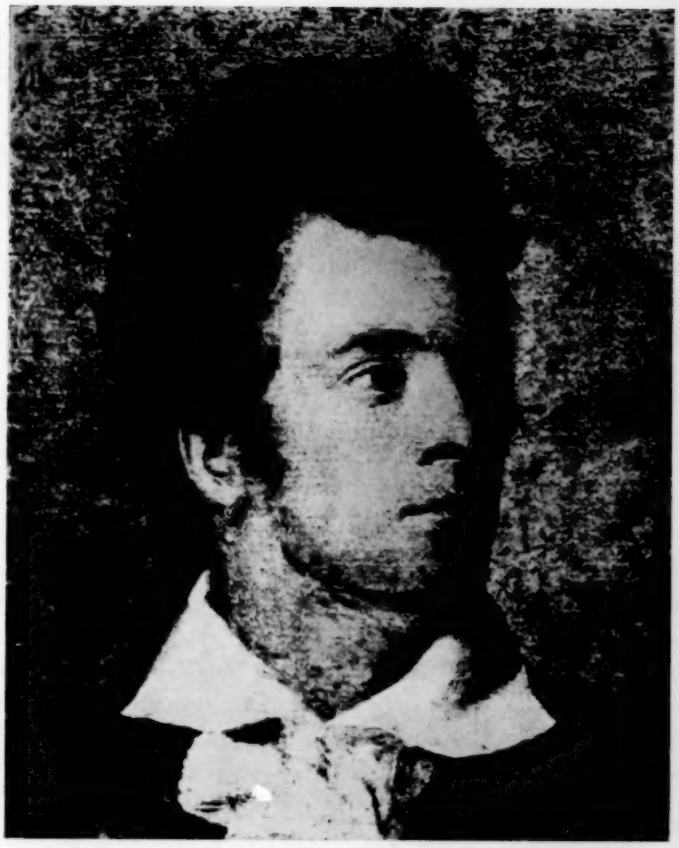
tedly received his artistic ability. Her large family of fourteen children were her constant care and attention. She died at Delta, Oneida County, N. Y., July 15, 1844, and is buried there. Of his parents Mr. CATLIN writes :

" ' My dear mother was a Methodist, and a devout Christian, and my father a philosopher, professing no particular creed, but keeping and teaching the commandments.' " (DONALDSON, p. 703).

These notes are not superfluous even in the briefest sketch, as they illustrate young CATLIN's environment : he did not have to go far to find Indian memories; he was bred and grew up in the midst of them. The rest of his early life may be told more rapidly. He read law in 1817-18 at Litchfield, Connecticut; practised law for a while, but his interest in painting becoming gradually predominant he established himself as an artist in Philadelphia in 1823. He painted many portraits in large size and also in miniature, the paintings of his which are most often quoted being a portrait of Mrs. DOLLY MADISON in a turban, the constitutional convention of Richmond, 1829-30 (including 115 figs.), and the portrait of DE WITT CLINTON, governor of New York. While he was painting the governor's portrait in Albany, he married CLARA B. GREGORY, who was a good wife and enthusiastic helper, accompanied him on many journeys and died in Paris, 1845. Conventional portrait painting was not much to CATLIN's taste (no wonder !) and he longed for some better application of his artistic tendencies. He has already told us in his own words how he finally found the very thing he needed : an ideal combination of artistic and outdoor life. The things he loved most : observations of Indian customs, painting, hunting, fishing were now beautifully united in his daily round of activities.

For eight years (1832-39) he lived among the Indians, traders, trappers and hunters of the wild West. He befriended the Indians and made many hundreds of portraits of their representative men and women. In spite of the fact that he generally managed to obtain their good will, he soon learned that it needed as much diplomacy to humour Indian sitters as any others, and in a few instances their fears of his " magic " exposed him to real danger.

During these years he used to stay with the Indians throughout the good season, then in the autumn he would paddle his canoe to a city, such as St. Louis or New Orleans and paint " paying "



Portrait of GEORGE CATLIN by himself (1824, Aet. 28).

Isis, XXII, pl. 12. G. SARTON

GEORGE CATLIN painting a chief at the base of the Rocky Mountains. (Frontispiece to his Letters and notes, 1841).

Isis, XXII, pl. 13. G. SARTON

portraits during the winter. These were the golden years of his life, I mean the years during which he accomplished his main destiny. After that, having accumulated a large amount of Indian paintings he traveled in Europe to exhibit them together with some live Indians whom he introduced to the Queen of England, the Kings of France and Belgium, and innumerable people of all kinds. These new adventures were quite successful at first, but CATLIN was not built for them and he finally lost in 1852 the modest competence he had managed to earn. Between 1852 and 1857 he returned to his natural sphere of activity, making three voyages from Paris to Central and South America, but these years were far less fruitful than the earliest ones spent among the northern Indians. Altogether he visited a great part of the Americas from one ocean to the other, and from Queen Charlotte Islands in the North to the Tierra del Fuego in the South : this at a time when such journeys were incomparably more difficult than at present, and when the American Far West, for example, was as wild and mysterious as Central Africa is to-day.

After his return from South America he settled for a time in Brussels (3), living with the utmost frugality. In 1872, he returned to the United States and was taken ill in Washington in October of that year. He hastened to Jersey City, New Jersey, where his daughters were established, and died there of Bright's disease on December 23, 1872. He was buried in Greenwood Cemetery, Long Island, by the side of his wife and child.

He was about five feet eight inches in height and rather thin (say, 135 pounds in weight), with a dark complexion, blue eyes and dark hair.

Captain MAYNE REID (1818-83)—who was as famous as CATLIN and is now almost as completely neglected—has left us a good sketch of his friend :

" In GEORGE CATLIN we saw one of the most graceful specimens of humanity we have ever encountered. Physically he was handsome—of the purest American type—so pure, indeed, that one could not help thinking he had a drop of aboriginal blood in his veins. His complexion was even darker than the ordinary brown

(3) From c. 1857 to c. 1872. One wonders whether there are no documents concerning him in the Belgian archives?

that distinguishes Brother Jonathan from his European ancestors. He was not sallow, but a fine, healthy bronze, part of which may have been produced by his long exposure to the wind and sun tan of the prairie. His figure was well proportioned, not large, but tersely compact; while in every gesture he was graceful... "

" Mentally he might not be what the world calls a genius, but morally he was beautiful. His simple manners and modest deportment made a favorable impression upon you at the first interview, and this was continued throughout all after intercourse. Along with it you felt a conviction of the incorruptible honesty and truthful sincerity of the man. Among the many public characters I have met, I can remember none who, so much as GEORGE CATLIN, strengthened within my mind the pleasant faith that, in this world of wicked people, there are still true, amiable men. " (4)

He was very frugal, eating but little meat and drinking no alcohol. Nor did he smoke except the few whiffs which were occasionally necessary in the Indian ritual of peace and friendship. He was very resourceful not only as a woodsman but as a mechanic. He had little sense of money, and though he earned substant al amounts of it at certain times he was not able to keep it, and remained poor. He was a good huntsman and storyteller, generous, and very fond of children. Like his father he was very religious-minded without belonging to any church.

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CATLIN was a good observer and a good draughtsman, but a mediocre artist. To be sure his difficulties were considerable. Just consider that he was generally traveling " with two other men in a small canoe, which in addition to his paints and canvas, held their clothing, bedding, ammunition and provisions; in fact, everything necessary for life and comfort in a land inhabited only by savages." Moreover, he was often obliged to work in great haste. If he generally managed " to catch the spirit of the scene before him and to transfer it faithfully to his canvas," (5)

(4) *Onward:* a magazine for the young manhood of America conducted by Captain MAYNE REID (only 2 vols. published and beginning of third, 1869-70). This passage printed in 1869, p. 401-2, as quoted by DONALDSON (p. 710, 712)

(5) WASHINGTON MATTHEWS, 1890, p. 595.

nevertheless his paintings and drawings would hardly survive as works of art. They must be judged as scientific documents, and as such their importance is considerable. To appreciate this it will suffice to imagine what it would mean to us if some men of CATLIN's type had flourished in ancient times or in the middle ages and left us similar testimonies of human scenes and personalities. CATLIN saw the Indians and lived with them when they were practically uncontaminated by the pernicious influence of white men. He observed and chronicled all the events of their daily life. (6) He saw the " noble savage " dear to the eighteenth century romanticists in his splendour and purity; he loved him, admired him, and took his defense at a time when this required much courage. Even toward the end of his life, when he had had abundant opportunities of hearing the other side of the story, he still reasserted his faith in those Indians whom he knew so well. Listen to this :

" ... I have had some unfriendly denunciations by the press, and by those critics I have been reproachfully designated the ' *Indian-loving* CATLIN.' What of this? What have I to answer? Have I any apology to make for loving the Indians? The Indians have always loved me, and why should I not love the Indians?

" I love the people who have always made me welcome to the best they had. I love a people who are honest without laws, who have no jails and no poor-houses. I love a people who keep the commandments without ever having read them or heard them preached from the pulpit. I love a people who never swear, who never take the name of God in vain. I love a people who ' love their neighbors as they love themselves !... I love a people who have never raised a hand against me, or stolen my property, where there was no law to punish for either. I love the people who never have fought a battle with white man except on their own ground. I love and don't fear mankind where God has made and left them, for they are children. I love a people who live and keep what is their own without locks and keys. I love all people who do the best they can. And oh ! how I love a people who don't live for the love of money." (7)

And this :

" The native grace, simplicity, and dignity of these natural people so much resemble the ancient marbles, that one is irresistibly led to believe that the Grecian sculptors had similar models to study from. And their costumes and weapons, the toga, the tunique, and manteau (of skins), the bow, the shield, the lance, so precisely similar to those of ancient times, convince us that a second (and last) strictly classic era is passing from the world." (8)

(6) Abundant examples in DONALDSON.
(7) *Last rambles* (London, 1868, 354).
(8) *Ibidem*, 357.

Surely such testimonies made by an honest man having no other interest than his love, must be remembered and treasured even if we discount the alterations of truth due to CATLIN's generosity and enthusiasm. And the fact that he was inspired to record them with so much persistance and emphasis, will always be to the credit of the Indian people, as well as to his own.

***

As often happens CATLIN's theories were not by any means on the level of his observations. The latter are excellent and irreplaceable, and their value permanent. The former are almost negligible. He explained his ethnological theories in chapters IX, X and XI of his "*Last rambles*" respectively entitled: "The Indians, where from?" "The Indians, who are they?" "The Indians, where are they going?" Of course he saw that they were doomed and that their days were counted, but it was hardly necessary to be a prophet to see that in the sixties.

"He believed that the primary race did not come here from abroad, but originated here on the soil independently of other races; although wanderers from other lands may have mingled with it. He found reasons for supposing that there may have been a Jewish element in the race, but not that the race was derived from the Jews; and he speculated upon the possible derivation of the Mandans from a Welsh colony under Prince MADOC in the early part of the fourteenth century." (9)

We need not insist upon this.

In 1870, he published a geological treatise "*The lifted and subsided rocks of America*," containing some fantastic views, which do not deserve to arrest our attention. The inquisitive reader may find a discussion of them in GEORGE P. MERRILL's *Contributions to the history of American geology* (Washington, 1906, 557) (10).

There is another connection between CATLIN and geology. A "red indurated clay from the Upper Missouri region used

(9) *Popular Science Monthly*, vol. 39, 408, 1891. With regard to his astonishing Welsh-Indian views, see appendix to his *Letters and notes* (New York, 1841, vol. 2, p. 259-65). This includes a short list of Welsh words compared with Indian ones.

(10) Or in the second edition (New Haven, 1924), but beware of it (*Isis*, 7, 498-501).

by Indians for tobacco pipes," (11) commonly called " pipestone " is named by mineralogists *catlinite*. It is said that CATLIN was the first white man ever admitted to the Pipestone Quarry where for " untold generations the red man had found material for his sacred calumets." The stone cuts easily from the quarry but hardens later. That famous quarry became a state park of Minnesota in 1925.

In 1842, having been invited to lecture at the Royal Institution, he suggested the creation of a " Museum of mankind," " containing the familiar looks, the manufactures, history, and records of all the remnants of the declining races of our fellow-men." (12) Of course ethnographical museums exist to-day in a great many cities and some of them at least must be anterior to CATLIN's suggestion.

While in London in 1845 (13) he applied for a patent for his invention of " disengaging and floating quarter-decks of steamers and other vessels for the purpose of saving human lives at sea", but found that he had been forestalled.

I have kept for the end another scheme of his, earlier in point of time, but more important than the others. In 1832, he originated the idea of national park, that is, an extensive reservation of public domains where man and beast would remain untouched and undefiled in their pristine purity and beauty. He concluded :

" I would ask no other monument to my memory, nor any other enrolment of my name amongst the famous dead, than the reputation of having been the founder of such an institution." (14)

This was assuredly a great idea, the prophetic nature of which will be realized better when we recall that the first national park, the Yellowstone, was not established until forty years later, and that eighteen more years had still to elapse before the creation of the second one, the Yosemite. (15) But since then the idea

(11) Definition taken from WEBSTER's Dictionary. The rest of the information on the subject borrowed from MARION ANNETTE EVANS' paper (1930).

(12) See CATLIN's *Notes of eight years' travels* (New York, 1848, vol. 1, 61-4, 246-7).

(13) See *ibidem*, p. 199-202. I think the date is 1845, but am not quite sure, as the author does not explicitly say so.

(14) *Letters and notes* (New York, 1841, vol. 1, 262).

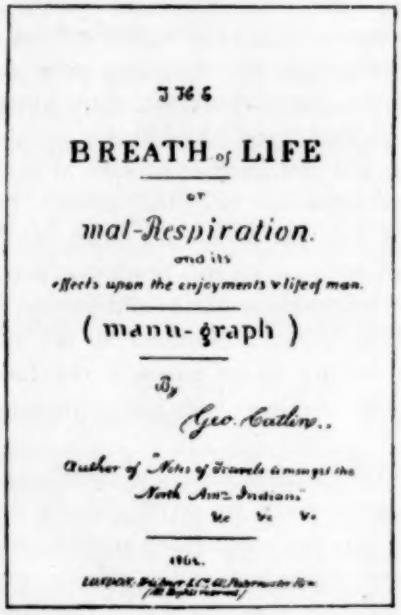
(15) True it is that the Hot Springs Reservation in Central Arkansas was

has spread considerably not simply in the United States but all over the world. We shall better appreciate its value when we sorrowfully remember the abundant opportunities of preserving natural beauty which have been irretrievably lost.

One of the best ways of honoring CATLIN's memory would be to remember him in one way or another in one of the National Parks. Visitors enjoying these " paradises " should be told that they owe them at least in part to his good genius.

* * *

I shall now deal with another book of CATLIN's which arrested my curiosity a few years ago, and was the origin of my interest in him and of this paper.



J 76 6

BREATH of LIFE

or

mal-Respiration.

and its

effects upon the enjoyments of life of man.

(manu-graph)

By

Geo. Catlin.,

Author of "Notes of Travels amongst the North Amer. Indians."

&c &c &c

1861.

It is not important, yet interesting. It is entitled *The breath of life or mal-respiration* and was originally published in London (1861) in " manu-graph." (See facsimile of title page). The

set aside as early as 1832, but its organization was not completed until 1880. (It is now a state park not a national one). To measure the extraordinary development of the idea in recent times, see article on National parks in the *Encyclopaedia Britannica* (14th edition).

purpose of it was to explain the danger of breathing through the mouth, and to urge people to train themselves and breathe as much as possible through the nose. CATLIN recalled his long experience as an observer of wild people " I have visited 150 tribes containing more than two millions of souls and therefore have had, in all probability, more extensive opportunities than any other man living, of examining their sanitary system." He claimed that their health and low mortality, especially infantile mortality, was largely due to their good breathing habits, assuring them a quiet and natural sleep. His was clearly the work of an enthusiast. He had reached the conclusion that sleeping with one's mouth open, in overheated rooms and feathery beds was the source of much ill health. He preached the gospel (for such it had to become to him) of cool bedrooms, open windows, and mouths shut ! So sure was he of the truth of his message that he wrote at the beginning of it (p. 2) :

" No person on Earth who reads this little work will condemn it : it is only a question how many millions may look through it and benefit themselves by adopting its precepts."

His arguments are not always the best and the scientific level of this booklet is rather low, but his main thesis has become a commonplace of modern hygiene. The importance of sleeping in a quiet and well ventilated room, and preferably on a hard bed, is now generally recognized, but there are still many people who do not understand that it is better to breathe with one's nose than with one's mouth, and have not been trained or trained themselves to do so.

I thought of that with special force a year ago when I was traveling in Transjordania near the Arabian border. I slept for three nights with a party of some twenty five persons in one of the caverns of Petra and was sorely tried by a terrible polyphony of snoring which revealed the bad breathing habits of some of my companions. This brought back to my mind CATLIN's book and I decided to examine it again after my return. Did Indians, pure and undefiled Indians, ever snore I wondered ?

The book is not easy to analyze as it is badly composed, but a few extracts will give a good idea of it.

" ... When I have seen a poor Indian woman in the wilderness, lowering her infant from the breast, and pressing its lips together as it falls asleep in its cradle

in the open air, and afterwards looked into the Indian multitude for the results of such a practice, I have said to myself—' glorious education ! such a Mother deserves to be the nurse of Emperors.' And when I have seen the *careful, tender-mothers* in civilized life, covering the faces of their infants sleeping in overheated rooms, with their little mouths open and gasping for breath; and afterwards looked into the multitude, I have been struck with the evident evil and—lasting results of this incipient stage of education; and have been more forcibly struck, and shocked, when I have looked into the Bills of mortality, which I believe to be so frightfully swelled by the results of this habit, thus contracted, and practised in contravention to Nature's design..." (p. 16).

" The Proverb, as old and unchangeable as their hills, amongst the N. Amⁿ Indians—' My son, if you would be wise, open first your Eyes—your Ears next; and last of all, your Mouth—that your words may be words of wisdom, and give no advantage to thine adversary '—might be adopted with good effect in Civilized life : & he who would strictly adhere to it, would be sure to reap its benefits in his waking hours; and would soon find the habit running into his hours of rest, into which he would calmly enter; dismissing the nervous anxieties of the day, as he firmly closed his teeth and his lips, only to be opened after his eyes and his ears in the morning; & the rest of such sleep would bear him *daily* and *hourly* proof of its value.

And if I were to endeavour to bequeathe to posterity the most important Motto which human language can convey, it should be in *three words* SHUT YOUR MOUTH.

In the social transactions of life, this might have its beneficial results, as the most friendly, cautionary advice, or be received as the grossest of insults; but where I would paint & engrave it—in every *Nursery*, and on every *Bed-post* in the Universe, its meaning could not be mistaken; and if obeyed, its importance would soon be realized." (p. 74).

Thus ends the first edition, except for a short appendix written in a different hand, and signed " Author. Rio Grande, Brazil, 1860."

There were many other editions—I have here a copy of the fourth " considerably enlarged," dated London 1870 and printed. It is entitled " ***Shut your mouth and save your life.***"

With regard to this " shut your mouth " injunction it may be worthwhile to recall that " CATLIN was always deaf in one ear, but about 1862 he became almost entirely deaf in both ears. This made conversation with him most difficult and rendered him a recluse. He avoided society, and only answered questions asked him in writing." (16) Did his increasing deafness and silence not have a part in the formulation of his strange creed?

The fourth edition has an undated appendix wherein the author

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(16) DONALDSON, p. 712.

reiterates the same idea with greater force and less criticism, and ends with the following extravagance (p. 102):

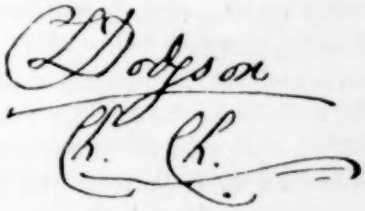
"I have lived long enough, and observed enough, to become fully convinced of the unnecessary and premature mortality in civilized communities, resulting from the pernicious habit above described; and under the conviction that its most efficient remedy is in the cradle, if I had a million of dollars to give, to do the best charity I could with it, I would invest it in four millions of these little books, and bequeath them to the mothers of the poor, *and the rich*, of all countries.

I would not get a monument or a statue, nor a medal; but I would make sure of that which would be much better—*self-credit* for having bequeathed to posterity that which has a much greater value than money."

I suppose that a great number of these booklets have been issued. The Harvard Library has no less than three copies: two of the second editions (manugraph, London, 1862) (17) and one of the fourth edition (London, 1870). One of the copies of the 1862 edition is especially precious as it bears an autograph of the well beloved CHARLES LUTWIGE DODGSON ("LEWIS CARROLL") the centenary of whose birth was celebrated last year all over the English speaking world (18).

I think that CATLIN's message "Shut your mouth" still deserves to be repeated, but as usual those who need it most will not listen to it, and alas! will continue to talk and snore.

Cambridge, Mass. GEORGE SARTON.
April 8, 1933.



(17) Probably identical with the first edition, 1861, except for date on title page.

(18) See, e.g., *Isis* 20, 564-6.

I. — *Brief list of* CATLIN's *main publication*

A complete list would be very long because of the abundance of editions and frequent changes in the titles. My list is compiled not for the satisfaction of bibliomaniacs and bookdealers but only for the convenience of scholars who wish to measure CATLIN's literary activity. For further details see JOSEPH SABIN : *Dictionary of books relating to America* (vol. 3; 435-38, New York, 1870); JAMES C. PILLING's bibliography included in DONALDSON's memoir of 1886 (p. 786-93); WILLIAM HARVEY MINER, Bibliography of CATLIN's work in *Proceedings and collections of the Wyoming Historical and Geological Society* (vol. 21, 25-39, 1930).

1, A. Letters and notes on the manners, customs and condition of the North American Indians. Written during eight years' travel among the wildest tribes of Indians in North America, in 1832-39. (2 vols. London, 1841; New York, 1841, VIII+264 p., VIII+266 p., 312 pl. & maps).

Second ed., 1842; third, 1842; fourth, 1843; fifth, 1845; sixth, 1846. After this the plates were sold to BOHN, and the following editions were entitled :

1, B. Illustrations of the manners, customs, and condition of the North American Indians, etc. Seventh edition. With 360 engravings from the authors' original paintings. (2 vols. London, 1848).

8th ed., 1857; 9th, 1857; 10th, 1866.

There are still other editions : e.g., Philadelphia, 1857; again 1860 (title A). London, 1876.

The latest edition is entitled " North American Indians. Being letters and notes on their manners, etc. (2 vols. 320 ill. in color on 180 pl., XII+298, XII+303 p., Edinburgh, JOHN GRANT, 1926).

Before being published in book form the Letters and notes appeared serially in the *New York Daily Commercial Advertizer*. I do not know whether there are any material differences between the serial and book publications.

German translation by HEINRICH BERGHAUS : Die Indianer Nord Amerikas und die während eines achtjährigen Aufenthalts under den wildesten ihrer Stämme erlebten Abentheuer und Schicksale. Nach der 5. englischen original Ausgabe. (XII+ 382 p., 20 pl., Brüssel, 1846-48). Again, 1851.

2. CATLIN's Notes of eight years' travels, and residence in Europe with his North American Indian collection. With anecdotes and incidents of the travels and adventures of three different parties of American Indians whom he introduced to the courts of England, France and Belgium (2 vols. New York, 1848, London 1848).

Reprinted under the title : Adventures of the Ojibbeway and Ioway Indians in England, France, and Belgium, etc. (2 vols., 632 p. London, 1852).

3. Notes for the emigrant to America. (Published by the author at his Indian Collection, 6, Waterloo, 15 p., London, 1848) (Copy in British Museum).

4. Museum of mankind (proposals for the construction of a floating museum). (London, 1851, again, 1852) (British Museum).

5. Steam raft. Suggested as a means of security to human life upon the ocean (16 p., 2 fol. pl., Manchester, 1860). (Library of Congress).

6. Life amongst the Indians. A book for youth. (XII+339 p., London, 1861).

Again, London, 1867; New York, 1867.

French translation by F. DE LANOYE : La vie chez les Indiens; scènes et aventures de voyage parmi les tribus des deux Amériques. Ouvrage écrit pour la jeunesse. (Paris, 1863).

Included in the famous series " *Bibliothèque rose* " and often reprinted : 1866, 1872, 1876, 1881, 1890, etc.

7. The breath of life or mal-respiration and its effects upon the enjoyments and life of man. 76 p. manu-graph. London, 1861; also New York, 1861) (Library of Congress and British Museum).

I have seen two copies of an edition dated London, 1862, which has all the appearances of a first edition. Later editions entitled : Shut your mouth. The breath of life... (76 p., New York, 1865).

Shut your mouth and save your life. (With 29 illustr. 102 p. Fourth edition considerably enlarged. London, 1870).

8. An account of an annual religious ceremony practised by the Mandan tribe of North American Indians. (67 p., quarto. London, 1865).

(50 copies privately printed.) CATLIN said of this edition (see SABIN, p. 436) : " It is a gross and mangled extract from my

account of the Mandan religious ceremony, printed and circulated without my permission or knowledge; of which I have demanded the surrender of every copy printed; and for any reprint or circulation of the same I will prosecute. September 22nd, 1865."

Copy in the Huntington Library.

9. O-kee-Pa : a religious ceremony; and others customs of the Mandans (VI+52 p., 13 pl. London, 1867; also Philadelphia, 1867).

On p. 45 see list of Mandan words compared with Welsh words ! Such comparisons were already made in his Letters and notes.

10. Last rambles amongst the Indians of the Rocky Mountains and the Andes. (X+361 p., London, 1868. Also, New York, 1868).

11. The lifted and subsided rocks of America with their influence on the oceanic, atmospheric and land currents, and the distribution of races. (XII+228 p., 1 map. London 1870).

Copy in Harvard Zoological Museum.

12. [Letter giving a brief outline of his erratic life amongst the aboriginal races of America.] To Mr. WILLIAM BLACKMORE, 8 rue de Brabant. à Bruxelles, April 16th, 1871.

Quoted after DONALDSON, p. 793.

To these items should be added (1) a series of Catalogues published by CATLIN in English and French to explain his Indian exhibitions, also (2) American parliamentary documents concerning the sale of his collections to the nation. Three documents of the second kind are available in the Harvard Library :

Report of the joint committee in the Library of the American Congress in relation to the purchase of CATLIN's Indian gallery. July 24, 1846 (1 p.).

Thirtieth Congress. Report no. 820. Aug. 8, 1848 (1 p.).

Memorial of GEORGE CATLIN to the Honourable the President of the Senate and the Speaker... Including recommendations by A. HUMBOLDT (1856), Prince MAXIMILIAN OF NEUWIED (1866), ADRIEN DE LONGPÉRIER (1864). Signed " GEO. CATLIN. Bruxelles, Belgium, Dec. 1868." (6 p.).

For a brief account of the vicissitudes of CATLIN's collections before they found a final resting place in the National Museum see W. MATTHEWS' paper of 1891.

II. — *Biographical*

1. Anonymous obituary in *Nature*, (vol. 7, 222, Jan. 23, 1873).

Short but good, e.g., it includes a brief but comprehensive account of his journeys not be found in my paper.

2. THOMAS DONALDSON : The GEORGE CATLIN Indian Gallery in the U.S. National Museum with memoir and statistics. (*Annual report of The Smithsonian Institution*, 1885, Part V of Part II, VII+939 p., 144 pl., Washington, D.C., 1886).

This contains abundant information on CATLIN's life and works, together with long extracts from his writings.

3. WASHINGTON MATTHEWS : The CATLIN collection of Indian paintings. Reprint of a lecture delivered at the National Museum April 13, 1889 (*Annual report of the Smithsonian Institution*, 1890, part II, 593-610, 21 pl., 1891).

4. (Anonymous). Sketch of GEORGE CATLIN (*The popular science monthly*, vol. 39, 402-9, New York, 1891).

Brief but good account largely derived from DONALDSON but including a few new facts.

5. WILLIAM HARVEY MINER : GEORGE CATLIN, a memoir and a bibliography (*The Literary Collector*, 1901). Not seen.

6. EDWIN SWIFT BALCH : The art of GEORGE CATLIN (*Proceedings of the American Philosophical Society*, vol. 57, 144-54, 1918).

7. R. P. TOLMAN : Article in *Dictionary of American biography* (vol. 3, 574, 1929). Too short and altogether insufficient.

8. Indian-loving CATLIN and his buffalo powder horn (*Proceedings and collections of the Wyoming Historical and Geological Society*, vol. 21, 39 p., ill., Wilkes-Barre, 1930).

Contents : CATLIN powder horn; Indian-loving CATLIN. By MARION ANNETTE EVANS ; Ancestry of GEORGE CATLIN; Bibliography of CATLIN's works, by WILLIAM HARVEY MINER. Seen only after completion of my own paper but used for the correction of it.

III. — *Iconography*

DONALDSON's memoirs contain three portraits of GEORGE CATLIN : " one a reproduction of one in oil, done by himself in 1824, when he was twenty-eight years of age; a copy of a water-

color portrait on ivory, a miniature done by WATKINS, in London in 1841, when Mr. CATLIN was forty-five years of age; and copy of a photograph of Mr. CATLIN, taken at Brussels in 1868, when he was seventy-two years of age." (p. 711). We reproduce here the first and most beautiful of these portraits.

A very interesting portrait painted by WILLIAM H. FISKE in 1849, owned by Mrs. LOUISE CATLIN KINNEY, was lent by her in 1904 to the National Museum in Washington. It represents CATLIN standing with a palette in his left hand a brush in the other; an Indian is standing to his right, both facing the spectator; other Indians in the background. There is a reproduction of it in Indian-loving CATLIN (1930, opp. p. 22).

IV. — *Thanks*

I am indebted for bibliographical information to Mr. MATTHEW WILLIAMS STIRLING, Chief of the Bureau of American Ethnology, and to Mr. WILLIAM HARVEY MINER of Saint Louis.

G. S.

Greco-Egyptian arithmetical problems: P. Mich. 4966 (*)

An ancient purist might properly object to the title of this paper, for though to us the problems to be discussed are arithmetical, in his eyes they would clearly fall in the field of logistic, the science of counting and reckoning as opposed to that which deals with the definition and classification of numbers and the relations of numbers. P. Mich. 4966 in fact consists of a table of fractions followed by a series of problems in mensuration, interest, money-changing, the reckoning of freight charges and such practical matters. It is at least interesting, if not significant, that the word *phiale* can be deciphered among the remnants of one of its most mutilated passages, (1) for the scholiast on PLATO, *Charmides* 163E, a much-cited authority on the scope of logistic, enumerates " phialite numbers " prominently among the subjects of that science. (2)

P. Mich. 4966 was purchased in Cairo in 1927; its finding-place is unknown and so is its author. It is however written in a hand belonging to the second century A.D. Unfortunately it is badly damaged; only the eight or ten upper lines of each column are preserved, and they in a far from perfect state; the lower part

(*) It is expected that the Greek text of this papyrus will be published under the auspices of the University of Michigan. P. Mich. 4966 and other Michigan papyri mentioned in this article are cited by their inventory numbers. Definitive numbers are being assigned them as from time to time parts of the collection are published by the University in its Humanistic Series. The editor desires to thank Professor L. C. KARPINSKI, Mr. H. C. YOUTIE and Mr. VERNE B. SCHUMANN of the University of Michigan, Professor A. S. HUNT of Oxford University, Dr. KURT VOGEL of Munich, and Sir THOMAS L. HEATH for helpful suggestions.

(1) Fragment III, i, 2. This passage is not translated below, for very little of it is left.

(2) Cf. D'OOGE-ROBBINS-KARPINSKI, *Nicomachus of Gerasa* (University of Michigan Studies, Humanistic Series, XVI), 1 f.

has disappeared almost entirely. Consequently conjectural restoration is necessary; some in practically every line, and much in some parts of the text. Luckily the editor, working on this ancient jig-saw and cross-word puzzle combination, can count on certain helps. Ancient arithmetic uses a vocabulary of its own, and in this papyrus certain phrases are constantly repeated (" as is needful," " I took such-and-such a fraction," " so much is the freight-charge," and the like), and even the same numbers are used, to some extent, in problems dealing with the same subjects. The conjectures about missing words may be guided by these land-marks, and in many cases their probability can be quite effectually checked by observing whether they are consistent with the parts of the original which are preserved, or with the arithmetic of the problem. Even conjecture, however, fails in some parts of the document, so little of which is left that they must be given up as beyond successful interpretation. There are 19 pieces of papyrus of fair size, 9 of which it has been possible to fit together consecutively to make the largest fragment, III. Fragments I (two pieces) and II (one piece) have been put before III chiefly because they are written in somewhat smaller and more cramped letters than most of III, the first part of which looks like I and II. Fragments IV-X are all small, and no connected context can be made out from them.

The papyrus offers no marked peculiarities in its mathematical expression or notation. It is full of symbols and abbreviations, but these do not differ markedly from those to be found in many other documents of its time. Except for $\frac{2}{3}$, the fractions which appear are all reduced to series of unit fractions, as is customary. A vertical line (|) is regularly used for the Greek γίγνεται or γίνεται, " it becomes, " " it makes," where we would use the sign of equality.

Mathematically P. Mich. 4966 cannot be said to be of extraordinary importance. It gains in interest, however, because it is an addition to an extremely limited group of documents, for out of the thousands of Greek papyri that have been found in Egypt and published, scarcely half a dozen are strictly arithmetical in character. (3) Of these three others are in the Michigan

(3) There are a certain number which deal with allied subjects—geometry, metrology, astronomy, astrology, and the calendar.

collection, P. Mich. 621 (a table of fractions), (4) P. Mich. 620 (quasi-algebraic problems), (5) and P. Mich. 1460 (unpublished; small fragment of a table of fractions). Very recently has been added P. Gr. Vindob. 19,996, a series of 33 stereometrical problems. Then there is the largest and most important document of this class, the Akhmîm papyrus, No. 10758 in the catalog of the papyri in the Cairo Museum. (6) It is a noteworthy fact that P. Mich. 4966 and the Akhmîm papyrus are alike in plan, if not in contents; for each consists of a table of fractions and a series of problems; (7) also the tables of fractions in the Akhmîm papyrus, P. Mich. 4966, P. Mich. 621, and P. Mich. 1460 (as far as it goes) are very similar. These general resemblances among most of the known representatives of a well-defined and limited class of papyri are significant, and probably point to a single use or purpose for the group, though what this was is not clearly indicated. If they were not school books or school-boy exercises (the latter is not very probable), they were most likely intended as collections of tables and typical examples for practical use. The writer is inclined to favor the latter alternative, considering the difficulties introduced into the simplest reckonings of every-day transactions by a cumbersome numerical notation and the habit of using only unit fractions, to say nothing of the multitude of standards of weights, measures, and money.

In the translation which follows the problems have been numbered in order, with the citation by fragment, column, and lines appended. The notes deal, it is hoped, with all the details of antiquities which need explanation. Since, however, a number of the problems concern freight charges on wheat, a special word may be said on this point. Egypt, as is well known, was Rome's granary. The grain was collected first from the fields and carried to various central depots, and thence to ports on the Nile, whence

(4) Published in *Classical Philology* XVIII (1923), 328-333; cf. *Isis*, V (1922), 20-25.

(5) Published in *Classical Philology* XXIV (1929), 321-329; cf. L. C. Karpinski and F. E. Robbins in *Science* LXX (1929), 311-314; K. Vogel in *Classical Philology* XXV (1930), 373-375.

(6) Published by J. Baillet, *Mémoires publiés par les membres de la mission archéologique française au Caire*, T. IX, fasc. 1.

(7) In the Akhmîm papyrus the table of fractions comes first. This is an additional reason for placing the table first in P. Mich. 4966.

it was transported by boat to Alexandria. The transportation by land gave rise to freight or carriage charges *(phoretron)*, which were reckoned in terms of measures (artabas) of grain according to a schedule; the *phoretron* expressed in artabas could then be converted into terms of money in accordance with a price *(timé)*. Problems 8 and 9 show, as indeed was to have been expected, that distance was a factor in reckoning *phoretron*, but strangely enough this has not clearly appeared in any of the previously known business or official documents in which *phoretron* is mentioned. (8)

Italics, in the translation, indicate words or phrases not expressed in the original but "understood." Square brackets enclose restorations made by the editor.

1. (= Frag. I, Col. i)

$$\frac{1}{23} = \frac{1}{23} \quad (9)$$

$$\left[\frac{2}{23}\right] = \frac{1}{12} + \frac{1}{276}$$

$$\left[\frac{3}{23}\right] = \frac{1}{10} + \frac{1}{46} + \frac{1}{115}$$

$$\left[\frac{4}{23}\right] = \frac{1}{6} + \frac{1}{138}$$

$$\left[\frac{5}{23} = \frac{1}{6} + \frac{1}{23}\right] + \frac{1}{138}$$

2. (= I, ii)

$$\frac{12}{29} = \frac{1}{4} + \frac{1}{8} + \frac{1}{29} + \frac{1}{232}$$

$$\frac{13}{29} = \frac{1}{3} + \frac{1}{15} + \left[\frac{1}{29}\right] + \frac{1}{87} + \frac{1}{435}$$

$$\frac{14}{29} = \frac{1}{4} + \frac{1}{5} + \frac{1}{58} + \frac{1}{116} + \frac{1}{145}$$

$$\frac{15}{29} = \frac{1}{2} + \frac{1}{58}$$

(8) In these the transactions are much like those represented by problems 10 and 11.

(9) This and the other entries in 1 and 2 are expressed in the form "(sc. $\frac{1}{23}$) of $1 = \frac{1}{23}$," etc., in the original. Some of the figures have been restored but in each line enough is preserved to make the restoration quite certain. Of Fragment I, iii only enough is left to show that it was a table of the same kind, and but one letter remains from I, iv, probably not from a table of fractions.

$$\frac{16}{29} = \left[\frac{1}{2}\right] + \frac{1}{29} + \frac{1}{58}$$
$$\left[\frac{17}{29} = \frac{1}{2} + \frac{1}{12}\right] + \frac{1}{348}$$

3. (= III, ii, 1-9) (10) To what number [may you add] 15, subtract 20, [add 25], and subtract 30; it will be 100 artabas of wheat? (11) As is needful, add together the added *artabas* (12); = 40; add together also the subtracted *artabas*, (12) [= 50;] from these subtract the added *artabas*, (12) [40; remainder,] 10; add to the 100 artabas of wheat, = 110; this is the number. Proof: ADD 15, = 125, and subtract 20; remainder, 105. Add [25] = 130; subtract 30; remainder, the given 100 artabas of wheat. (13)

4. (= III, iii, 1-4) *Reduce to silver drachmas* 43 talents 2000 *drachmas* of copper, on the basis of one stater to 1200 copper *drachmas*. As is needful, reduce the 43 talents 2000 *drachmas* to myriads of drachmas; (14) take $\frac{1}{1200}$ of these = 216 $\frac{2}{3}$ staters; multiply [these] by 4 (since the stater contains 4 drachmas), = [866] drachmas 4 obols. (15)

5. (= III, iii, 5-7) *Reduce to silver drachmas* 5800 copper drachmas, on the basis of one stater to 1200 copper drachmas. As is needful, I took $\frac{1}{1200}$ of the given 5800 drachmas, = 4 1/2 . 1/3 staters; multiply these by 4 (since the stater contains 4 drachmas), = 19 drachmas 2 obols.

6. (= III, iii, 8-11) (16) *Reduce to copper drachmas* 3 talents

(10) Very little remains of II and III, i, which are omitted from this translation for that reason. II apparently contained exercises in simple arithmetical operations (division and multiplication).

(11) What might quite as well have remained an exercise in abstract numbers is thus made concrete in accordance with the Greco-Egyptian preference.

(12) The gender of the participles shows that "artabas" must be understood in these three instances.

(13) The remainder of the column is very fragmentary and is omitted.

(14) I.e., this sum was stated as 260,000 (26 myriads) drachmas. 1 talent = 6000 drachmas. As may be inferred from this and the following problems Egypt used both silver and copper coins bearing the same names. In value the ratio of silver to copper in imperial times was 300:1, as here shown; in late Ptolemaic times it was as high as 500:1.

(15) In this and in No. 5 the fractions of a drachma are expressed in obols (6 obols = 1 drachma).

(16) This problem is much mutilated in the text, but the remaining words and figures, and the analogy of the previous problems make the restoration reasonably certain in its general lines.

2000 drachmas of silver, on the basis of one stater to 1200 copper drachmas. As is needful, reduce the [3 talents 2000 drachmas to] myriads [of drachmas, = 20,000; of these take 1/4,] because the stater [contains 4 drachmas; = 5000] staters; [multiply these into the] 1200 copper [drachmas, = 6,000,000] copper [drachmas, = 1000 talents of] copper.

7. (= III, iv) Of 100 loads, some are at the rate of 10 drachmas, (17) some at 20 drachmas, (18) and some at 30 drachmas (19); the whole price is 2500 drachmas. As is needful I multiplied the 100 loads × 30 drachmas = 3000; from this subtract the given 2500 drachmas; remainder, 500 drachmas. And subtract the 10 drachmas from the 30 drachmas; remainder [20]. I took 1/20 of the remainder, 500 drachmas, = 24 with remainder of 20; and subtract the 20 drachmas from the 30 drachmas; remainder 10 of the original. And one operates with 20 because it is necessary to subtract the 10 drachmas from 30; remainder, 20 once = 20; take besides 20 (since I took 1/20 of the remaining 500 drachmas and it was 24 with remainder of 20), = 40; take 1/10 of this (because you have subtracted 20 drachmas from 30 drachmas and 10 were left), = 4; = 1, since [4 × 1] = 4, for [I took $\frac{1}{4}$] of [4]; and subtract 1 from 24 (since I took 1/20 of the [remainder], 500 drachmas, and it was [24 with remainder of 20]); 23 is left; so many are the loads at [10] drachmas, = 230 drachmas. Put above the [10 drachmas] the 23 loads and below them the 230 drachmas. I took [10 from the] 20 drachmas, = [10, and] $\frac{1}{10}$ of the 40 drachmas, [= 4; and] put [above the 20 drachmas the] 4 loads, [and under the 20 drachmas the] 80 [drachmas;] add 4 [+ 23 = 27]; subtract [230 drachmas from] 2[500 drachmas, = 2270 drachmas; and subtract 80 drachmas from 22]70 drachmas = 21[90 drachmas; and subtract the 27 loads from the 100 loads = 73; add 23 + 4 + 73 = 100, and] add [270 + 80 + 2190 drachmas = 2500 drachmas.] (20)

(17) In the original " 23 loads " is written above, and " 230 drachmas " below, the words " 10 drachmas." These are parts of the solution and directions for so setting them down are explicitly given later in the problem.

(18) Here are written " 4 loads " and " 80 drachmas," above and below the line.

(19) Here " 73 loads " and " 2190 drachmas " are inserted above and below the line.

(20) A large part of the conclusion of this problem has to be restored, and the restoration is not entirely certain. However, it seems to fit the few words

8. (= III, v, 1-4) Add (21) [$\frac{1}{2}$] to 2 = 2 1/2; and [add] the [$\frac{2}{3}$] represented by the 20 stadia to the 3 schoeni = 3 2/3; reduce the 2 1/2 to halves; it is 5; and the 3 2/3 to halves; it is 7 1/3, [of which] $\frac{1}{5}$ = 1 . $\frac{1}{5}$. $\frac{1}{6}$. $\frac{1}{10}$; *this multiplied* into 4 1/2 artabas = 6 [$\frac{1}{2}$. $\frac{1}{10}$ and] *multiplied* into the 60 artabas = 396, $\frac{1}{100}$ of which = 3 $\frac{1}{2}$. $\frac{1}{4}$. $\frac{1}{5}$. $\frac{1}{100}$. So much they pay for 60 *artabas* over the distance of 3 schoeni 20 stadia.

9. (= III, v, 5-8) The freight on [100 artabas] for 3 schoeni is 3 1/2 [artabas;] according to schedule there is a freight charge of 60 artabas; how many artabas will be delivered over a distance of 4 schoeni? As is needful I took [$\frac{1}{3}$] of the 4 schoeni [=] 1 $\frac{1}{3}$; *this multiplied* into the 3 1/2 artabas = 4 [$\frac{2}{3}$, which reduced to] thirds = 14; (22) and the 60 artabas *reduced* to thirds = 180, $\frac{1}{14}$ [of which] = 12 $\frac{1}{2}$. $\frac{1}{3}$. $\frac{1}{42}$; *this multiplied* into 100

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preserved in these lines, and to be consonant with the procedure followed in solving the problem. There are two more lines at the end of this column, not translated because little of them is left. Perhaps they are part of another problem.

I add here a summary of comments on this problem which Sir Thomas L. Heath kindly has furnished. Starting with the equations

(1) $x + y + z = 100$

(2) $10\,x + 20\,y + 30\,z = 2500$

the scribe multiplies (1) by 30 and subtracts (2) from the resulting equation, leaving $20\,x + 10\,y = 500$. To find values for x and y he now divides 500 by 20 in such a way as to leave some remainder (to form $10\,y$); thus,

$20.24 + 20 = 500$.

Then, letting $x = 24$, he has the result $10\,y = 20$ or $y = 2$. This would give a solution, but for some reason or another he is not content with it—perhaps he did not notice it—but proceeds. Now since 20 is the coefficient of x derived from 30-10, we might take 20 off that term and add it to the 20 representing $10\,y$. We have then $20 + 20 = 40 = 10\,y$. Divide by 10 and $y = 4$. Having taken 20 from the first term ($20\,x$), the author has to subtract 1 from the factor 24, which leaves 23. With these values for x and y it is easy to complete the solution.

(21) The first few lines of this problem, containing the statement of its terms, were at the bottom of the preceding column and are lost. They are to be restored somewhat as follows: "The freight on 100 artabas for 2 schoeni 15 stadia is 4 1/2 artabas; what is the freight on 60 artabas for 3 schoeni 20 stadia?" There may also have been the explicit statements that 15 stadia are 1/2 of a schoenus (30 stadia) and that 20 stadia are 2/3 of a schoenus. This explains the first line, in which the distances are reduced to terms of schoeni alone. The solution is in terms of artabas in accordance with the usual method of paying *phoretron*.

(22) This operation, although not so explicitly stated, is apparently the same as that employed in Nos. 8 and 12. The papyrus has [εἰς] γ′ | ιδ, and γ′ (with the accent) usually means $\frac{1}{3}$, though sometimes 3. Conceivably it might mean "multiplied by 3 = 14," which gives the same result; but in that case ἐπί would be more natural than εἰς, and the latter is the more probable restoration because

artabas = 1285 $\frac{2}{3}$. $\frac{1}{21}$; so many *artabas* will be delivered for 60 artabas [over a distance of] 4 schoeni. (23)

10. (= III, vi, 1-2) The freight on 100 artabas is [5 artabas]; given a charge of 80 artabas how many artabas in the principal? (24) As is needful, I took [1/5 of] 80 = 16; ***multiplied*** into 100 = 1600; so many ***artabas*** in the principal.

11. (= III, vi, 3-4) The freight on 100 artabas is 5 artabas; what is the freight on the whole principal amount of 1000 artabas? As is needful I multiplied [5] × 1000 = 5000, of which $\frac{1}{100}$ = 50; so many ***artabas*** are the freight.

12. (= III, vi, 5-8) The width of a field is [2 1/2] schoenia; (25) what is the length that there may be 20 arouras? As is needful, reduce the [2 1/2 schoenia to] halves, = 5; and the 20 arouras to halves, = 40; of which $\frac{1}{5}$ = 8; this is the length. Proof: Multiply the 2 1/2 schoenia of the width × [8] of the length and it equals the given 20 arouras. (26)

13. (= III, vii, 1-4) The [monthly] interest [on 100 drachmas is 2 drachmas 3 obols] (27); let 4 months pass, and the whole sum be 1100 drachmas; what is the [principal? Multiply] the 2 drachmas 3 obols into the [4 months,] = 10; into 1100 = 11,000, [of which $\frac{1}{100}$ =] 110 drachmas; I took $\frac{1}{110}$ of 11,000 = 100; this is the interest on 1000 for 4 months.

14. (= III, vii, 5-7) The [monthly] interest [on 100 drachmas] is 2 drachmas 3 obols; let 4 months pass and the principal be 200 drachmas; what is the interest? [Multiply] the 2 drachmas 3 obols into the [4] months = 10; into 200 = 2000, of which 1/100 = 20; so much is the interest.

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in the very next phrase, regarding the 60 artabas, we have, similarly, *εἰς γ′ | ρπ* perfectly preserved in the text. The interpretation adopted is undoubtedly to be preferred.

(23) The remainder of column v is too much damaged to translate. It contained, however, at least three more problems dealing with freight charges on grain, as shown by the scanty remains.

(24) *κεφάλαιον*, usually meaning the principal sum (in money) on which interest, etc., is based, here refers to the " principal amount " of grain on which the freight of 80 artabas is paid.

(25) An aroura is a square schoenium. The " royal schoenium " contained 100 ells and the " geometrical schoenium " 96. The schoenus, a larger measure, contained 12,000 ells or 30 stadia.

(26) This was followed by two more problems in areas, doubtless similar to No. 12, and one dealing with interest. Not enough is left to translate.

(27) I.e., 2 1/2 drachmas.

15. (= III, vii, 8-10) There are 30 artabas of wheat [measured] by the 36-choenix measure; how many will there be by the 40-choenix measure? (28) [Multiply] the 30 artabas of wheat by the 36 [+] 1080, of which $\frac{1}{40}$ = 27. [There are so many by the 40-]choenix measure. (29)

16. (= V, 24) ... the mile contains [7 1/2] stadia ... contains 4 geometrical schoenia ... and the mile contains ...

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(28) This problem, as is obvious, deals with the conversion of amounts stated in terms of artabas of one standard into another. A papyrus in the British Museum, P. Londin. II, 265, is entirely concerned with similar examples and shows that there were many kinds of artabas.

(29) The next problem begins with the word " loads " (cf. No. 7) and probably deals with freight charges. The remainder of the column, however, is badly damaged and untranslatable for that reason. The same is true of the remaining fragments (IV-X). IV seems to concern " loads," V measures of length (the few remaining phrases are given above,) and the others variously sums of money, artabas, etc. They are all extremely brief.

Importance of the Greek algebraical problems

The recent discovery of the solution of the quadratic and even the formulation of cubic problems in Babylon as early as 2000 B.C. places entirely new problems before the historian of mathematics. The algebraical problems of DIOPHANTOS, the development of application of areas with its algebraical implications, and particularly the rectangle problems (80 to 85) in EUCLID's Data, all take on new significance in the light of the ancient developments in Babylon. The relationship of Egyptian algebraic ideas also requires new examination.

In these problems it is interesting to note that $\frac{2}{23}$ is resolved into the same two fractions as in the Ahmes Papyrus. $\frac{4}{23}$ appears as the simple double of $\frac{2}{23}$ and $\frac{5}{23}$ as the sum of $\frac{1}{23}$ and $\frac{4}{23}$, the use of the same denominator in the resolved fractions being somewhat uncommon.

The exchange and cost problems involving the rule of three call for no particular comment but the third problem, involving addition of positive and negative amounts, presents further evidence of the Greek interest in this fundamental concept of algebra.

Undoubtedly the greatest interest in this series of problems attaches to the seventh problem, the system of indeterminate equations,

$$x + y + z = 100$$
$$10x + 20y + 30z = 2500$$

It is comparatively simple to set up the series of 26 sets of positive integral values (including 0) of x, y, and z or x, $50\text{-}2x$, and $x + 50$ respectively, which give the solutions in integers of the given equations.

The interesting fact is that the outline of the solution follows

somewhat the modern procedure in eliminating x or y and arriving at the relations,

$$y + 2z = 150$$
$$\text{and} \quad z - x = 50$$

Unfortunately the author presents but one solution which seems to be chosen at random.

These linear indeterminate equations which received early the most complete treatment in India present material of the utmost importance for the development of mathematics. It is significant to find this material in this somewhat chance selection of mathematical problems.

The interest problem in which the amount produced by an unknown sum of money after four months at a given rate of interest corresponds closely to the inverse problems in interest which have become almost a classical part of American instruction in the theory of interest. This type of problem seems to have originated in India although this example might indicate that it originated independently also in Greece.

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The *Microcosmographia* of Trier MS. 1041

MS. 1041 of the *Stadtbibliothek* of Trier is a compilation of brief treatises of the later Middle Ages. (1) Most of them are philosophical or theological in character, works of such important men as ANSELM, BERNARD, and HUGO OF ST. VICTOR which are available in many other MSS. One, however, entitled by its author *Microcosmographia*, appears to be extant in this MS. alone. (2) The existence of such a treatise has long been known and references to it in modern works dealing with the intellectual history of the 12th century are by no means lacking. A letter of dedication which precedes the treatise proper and a list of the captions of its chapters were published many years ago. (3) Yet, as far as I am aware, no analysis of the contents has ever been attempted. Possibly such neglect has been in large measure deserved. Still it is somewhat surprising that the author's admiration for the " ancients " and disdain for the " moderns " professed in the letter of dedication should have so signally failed to attract attention to the treatise itself.

The editors of the catalogue of MSS assign the compilation as a whole to the 14th century. From a paleographical standpoint, however, the *Microcosmographia* itself might well be a product of the preceding century. Yet there is no reason to believe

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(1) For full description of the MS., see *Beschreibendes Verzeichnis der Handschriften der Stadtbibliothek zu Trier* (Trier, 1911), pp. 125-126.

(2) I have already commented briefly upon the treatise in my article, " William of the White Hands and Men of Letters," in *Anniversary Essays in Mediaeval History by Students of Charles Homer Haskins*, edited by C. H. TAYLOR and J. L. LA MONTE (Boston and New York, 1929), pp. 384-386.

(3) By E. MARTÈNE and V. DURAND, *Veterum Scriptorum Amplissima Collectio* (Paris, 1724-33), I, 946 ff. Reprinted by J. P. MIGNE, *Patrologia Latina*, CCIX, 869-872.

it an author's original. There is, on the contrary, conclusive evidence that it is a copy. (4) But fortunately the date of the original can be determined from data provided by the author himself in his letter of dedication.

The letter is addressed to " Willelmo dei gratia remensi archiepiscopo et apostolice sedis legato." Undoubtedly this was WILLIAM OF THE WHITE HANDS, who was archbishop of Rheims from 1176 to 1202. (5) Yet even greater precision is possible. Prof. HASKINS has already called attention to the fact that the prelate is not given the title, cardinal. (6) As this was bestowed upon him by ALEXANDER III in 1179, it may be assumed that the work in question first saw the light between 1176 and that year.

This conclusion is supported by the fact that in the MS. the *Microcosmographia* is preceded by a brief astrological forecast for 1178. As one and the same scribe copied this forecast together with the first half of the treatise, it is highly probable that they were taken from a single source. Moreover the observations upon which the forecast is based appear to have been made at Rheims. (7) The juxtaposition of the two does not, then, seem to be entirely a matter of chance.

(4) This is indicated by the fact that fols. 3-18 *v.* are in one hand, while fols. 19-43 are in a different one. Moreover the fairly numerous errors are of such a character as only a scribe would make. See " William of the White Hands and Men of Letters," *loc. cit.*, p. 385, n. 126.

(5) Cf. " William of the White Hands and Men of Letters," *loc. cit.*, p. 384.

(6) *Studies in the History of Mediaeval Science* (second edition, Cambridge, 1927), p. 92, n. 56.

(7) This forecast, fols. 1-2 *v.*, contains a number of interesting features. At the top of fol. 1 stand the words : " Incipit figura anni. m. c. lxx. viii. et eorum que in ipso futura sunt per astronomiam facta." Directly below is a rectangular diagram, approximately 13 centimetres long by 8 wide, divided by diagonal lines into the twelve astrological " houses." The positions of the planets in the " houses " are indicated in degrees by *Arabic* numerals. No attempt at greater precision was made. Under the diagram the forecast begins : " Hec est figura anni facta *superrenus*. m. c. 87. anno ab incarnatione domini, quinta die marcii, tertia decima hora, que fuit hora Jovis." Clearly *superrenus* is a mis-reading of *super* followed by a place name. This was very probably *remis*. It would have been exceedingly easy for the copyist to have taken *mi* for *nu*. The second date, partly Roman and partly Arabic, does not seem to tally with that given in the superscription. The apparent discrepancy is due, no doubt, to the fact that the Arabic numerals were at first written from right to left rather than from left to right. Cf. G. F. HILL, *The Development of Arabic Numerals in Europe* (Oxford, 1915), p. 19. That this is indeed the case is indicated by

In the letter of dedication the author gives his name as WILLIAM. As his treatise itself is highly objective in character, very little more can be learned about him. One personal trait only can be distinguished. WILLIAM bears a grudge against the *medici* whom he stigmatizes as *odiosophi*. At the same time he entertains great respect for the *physici*, among whom he clearly numbers himself. These, he holds, are the true *philosophi*. (8) Fortunately he himself explains the distinction. Some philosophers, he remarks, have held the soul to be water, " alii crasin..., velud quidam medici, ne dicam medici qui totam fisicam in stercoris et urine inspectione autumant consumari, *que in tocius nature celestium corporum et terrenorum omniumque superiorum et inferiorum contemplatione consistit*, ideoque plures possumus apellare medicos, paucissimos autem phisicos, quorum omnium errores levissime dissolvimus." (9) Thus WILLIAM admiringly regards the *physici* as natural philosophers in a broad sense of the term, while he despises the *medici* as narrow practitioners, who totally lack comprehension of the fundamental interrelations of nature. His definition is, of course, quite unoriginal. (10) Nevertheless his

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the Arabic numerals in the diagram itself. Thus, Mars is given in *Libra* in what appears to be the 91st degree ! This is impossible. Read from right to left, however, the 91st becomes the 19th degree. The fact that in the 13th century, if not earlier, the year began at Rheims on March 25 raises the question whether the date was actually 1178 or 1179. The astrologer's use of the phrase *anno ab incarnatione domini* does not necessarily mean that he began the year with Christmas. It is very significant, however, that in 1178 March 5 fell on a Sunday, for it is on Sunday that Jupiter controls the 13th hour. Hence 1178 seems more probable than 1179. There is one discrepancy in the forecast that I am at a loss to explain. The date is given as March 5. Yet the sun is recorded as in the 1st degree of *Aries !* According to my calculations the sun entered *Aries* in 1178 on March 14.

(8) Fol. 23 *v.* : " Quia igitur de his quinque (the senses) inter philosophos multe et maxime erant dubitationes et disputationes, in quarum plerisque adhuc sub iudice lis est, pauca de his ad phisicos tamen tantum, non ad medicos, ad philosophos, non ad odiosophos pertinentia pertractemus." See also fols. 10 *v.*-11; 12; 40 *v.*

(9) Fols. 10 *v.*-11.

(10) A definition suggestive of WILLIAM's is given by ALCUIN, *Dialogus de rhetorica et virtutibus*, in MIGNE, P. L., CI, 947-948 : " Physis, natura; Physica naturalis, quae de natura omnium rerum ex contemplatione disputat." Equally suggestive is a definition given by RADULFUS DE LONGO CAMPO (ca. 1216) : " Physica enim est scientia tractans de naturis omnium rerum que sunt sub lunari globo et etiam quarumdam supra." Cf. M. GRABMANN, *Geschichte der scholastischen Methode* (Freiberg i. B., 1909-11), II, 50, n. 1.

attitude toward natural philosophy is of more than passing significance, as it is the only markedly subjective element apparent in the pages of his treatise.

This attitude raises, moreover, the question whether the *Microcosmographia* and the astrological forecast may not have been the work of a single man. The juxtaposition of the two in the MS., the correspondence of time, the probable connection of the forecast, and the undoubted connection of the treatise with Rheims make this plausible. Certainly there is room for astronomy and astrology within WILLIAM's definition of *physica*, and close scrutiny of the *Microcosmographia* does indeed yield evidence of familiarity with them. On one occasion he expresses very clearly his belief in the efficacy of astrology. Like many other writers, to be sure, he is careful to distinguish between *divinitio superstitiosa* and *divinitio naturalis*. As pertaining to the former, he lists *nigromantia*, *ciromantia*, *geomantia*, *idromantia*, *aerimantia*, *piromantia*. But the latter, he explains, " est que inspecta ratione astrorum ea per ipsam naturaliter fiunt rationabiliter predicit, *sicut astronomia*." (11) It is plain that he is using *astronomia* to designate what would be called astrology today, for elsewhere he explains that *astrologia* is the theoretical side of the science of the stars, while *astronomia* is its practical application. (12) The consistency of this interpretation of *astronomia* with the heading of the astrological forecast, " Figura anni... *per astronomiam facta*," is to be noted.

But the most striking indication of familiarity with astronomy is found in a discussion of sight and optical illusions. Here WILLIAM notes the following : " Item cum luna existente iuxta solem etiam infra. XXX. gradus, quando scilicet a nobis videri non potest, eius ymago speculo adveniat in eoque videatur." (13) The technical character of this observation suggests an experienced

(11) Fol. 32. See also fol. 9 *v.* : " ... arte etiam sapiens, ut mathemacus, futura predicit."

(12) Fol. 38 *v.* : " Et attende quod sicut diversa sunt theorica et practica cuiuslibet artis, ita theorica et practica anime. Unde sicut aliquis in arte aliqua bonus theoricus est et pravus practicus, ut bonus rethor et pravus orator, bonus logicus, pravus dialecticus, *bonus astrologus, astronomicus non bonus*, ita...." See on this point, G. SARTON, *Introduction to the History of Science* (Baltimore, 1927-), II, 21, 760, 990.

(13) Fol. 24 *v.*

astronomer or astrologer rather than a layman. Other, though less striking indications of this are not lacking. References to sun, moon, and stars occur with considerable frequency in the *Microcosmographia*. (14) Moreover, on one occasion, the great Saracen astrologer, ALBUMASAR (ABŪ MA'SHAR), *summus ille philosophus*, is cited, though not on a topic particularly relevant to astrology. (15) It is not improbable, therefore, that WILLIAM was likewise the author of the forecast.

Yet assuming this to have been the case, he remains a figure shrouded in obscurity. The *Histoire Littéraire de la France* assumes that he was WILLIAM OF SOISSONS, whom JOHN OF SALISBURY tutored. (16) No justification for this identification is given. Probably it is based on nothing more substantial than conjecture. But even less likely is the Abbé CLERVAL's identification of the author of the *Microcosmographia* with WILLIAM OF SAINT-THIERRY. (17) WILLIAM OF SAINT-THIERRY died in 1147 or 1148, some thirty years too early. (18) No doubt, CLERVAL was influenced by the coincidence of names and possibly he confused the *Microcosmographia* with WILLIAM OF SAINT-THIERRY's *De natura corporis et animae*. Such confusion would be easy in view of the fact that both works make extensive use of a source which will be discussed presently. Actual comparison proves, however, that they are quite distinct. On certain topics the views of the author

(14) Fols. 18 *v.*; 27 *v.*; 37 *v.*

(15) Fol. 7: "... sed proximus attigit veritatem summus ille philosophus, albimasar, dicens: Nascetur virgo puella vultu et specie decora, habens in manibus geminas aristas puerum nutriens ac iure lactans, cui nomen ebraice iesus, grece autem christus." The quotation is from the *Introductorium in Astronomiam*. Cf. *Opus introductorii in astronomiam albumazaris abalachi* (RATDOLT, Augsburg, 1489), Bk. VI, ch. 2. This treatise was available to WILLIAM in Latin. See SARTON, *op. cit.*, II, 170, no. 4, and 173, no. 3.

(16) Vol. IX, 191. As to WILLIAM OF SOISSONS, see JOHN OF SALISBURY, *Metalogicon*, ed. C. C. J. WEBB (Oxford, 1929), p. 81.

(17) *Les écoles de Chartres au moyen âge* (Paris, 1895), p. 275.

(18) Cf. A. ADAM, *Guillaume de St.-Thierry* (Bourg, 1923), p. 98. In my article, "William of the White Hands and Men of Letters," I said, p. 385, n. 127, that WILLIAM OF SAINT-THIERRY died "before 1176." Apparently Prof. POWICKE took this to mean that he died shortly before 1176. He does not, therefore, consider WILLIAM OF SAINT-THIERRY's authorship impossible. Cf. his review of the *Anniversary Essays* in *English Historical Review*, XLV (1930), 644. I very greatly regret the vagueness of my phraseology, but I hope that Prof. POWICKE will now agree that there is strong evidence against WILLIAM OF SAINT-THIERRY's authorship.

of the *Microcosmographia* are diametrically opposed to those of WILLIAM OF SAINT-THIERRY. Thus, the latter explains vision by rays emanating from the eye to the object. (19) In the *Microcosmographia* this view is flatly rejected. (20) If the two were indeed written by a single man, it is difficult to see how such contradictions can be explained.

Assuming that the author of the *Microcosmographia* was also the author of the forecast for 1178, could he have been that WILLIAM THE ASTROLOGER, who, according to ROGER OF HOVEDEN and BENEDICT OF PETERBOROUGH, terrified many people by a prediction of frightful calamities to occur in the fall of 1187? (21) WILLIAM was an exceedingly common name in the 12th century. Yet it is claimed that professional astrologers were by no means numerous in North-Western Europe in the period in question. (22) The nine year interval between the two forecasts is certainly sufficiently brief to admit the possibility of common authorship. The earlier, to be sure, seems to have been made at Rheims, while the later one apparently originated in England, since WILLIAM THE ASTRONOMER is described as a clerk of JOHN, Constable of Chester. (23) But this difference of locality constitutes no serious obstacle to identification. Many Englishmen were, at one time or another, associated with WILLIAM OF THE WHITE HANDS, (24) and that prelate himself made at least two visits to England. (25)

Another approach to this problem lies through a comparison

(19) *De nat. cor. et an.*, in MIGNE, *P. L.*, CLXXX, 705.

(20) See *infra*, pp. 129-130.

(21) HOVEDEN, *Chronica*, ed. by W. STUBBS (Rolls Series, London, 1868-1871), II, 292-293; BENEDICT, *Gesta Regis Henrici Secundi*, ed. by W. STUBBS (Rolls Series, London, 1867), I, 324-328. For a discussion of the prediction, see T. O. WEDEL, *The Mediaeval Attitude toward Astrology* (New Haven, 1920), pp. 91-94.

(22) WEDEL, *op. cit.*, pp. 90-91; G. HELLMANN, "Die Wettervorhersage im ausgehenden Mittelalter," in *Beiträge zur Geschichte der Meteorologie*, II (Berlin, 1917), nr. 8, 204.

(23) No other trace of WILLIAM THE ASTRONOMER is to be found. JOHN DE LACY was Constable of Chester from 1172 to 1190. Cf. W. F. IRVINE, "Chester in the 12th and 13th Centuries," in *Journal of the Architectural, Archaeological, and Natural History Society of Chester*, new series, X (1904), 15, n. 3.

(24) Cf. "William of the White Hands and Men of Letters," *loc. cit.*, pp. 370-372.

(25) J. MATHOREZ, *Guillaume aux Blanches Mains, Évêque de Chartres* (Chartres, 1912), pp. 22; 27.

of the forecast in the Trier MS. with that for 1187 as reproduced by HOVEDEN. In form and method there is a certain similarity between them. But here the likeness stops. The later forecast is much more detailed than that for 1178, which is very simple and general, confining itself to the prediction of a few great events and the prophecy of weather conditions to prevail at the various seasons of the year. The later forecast displays, moreover, a more extensive technical vocabulary and closer acquaintance with Saracen astrology. Yet this difference does not render common authorship impossible, for the astrologer could well have widened his contacts and lengthened his vocabulary in the years between 1178 and 1187. But admittedly it cannot be proved that the author of the *Microcosmographia* was WILLIAM THE ASTROLOGER.

The most convenient approach to the treatise itself lies through the sources upon which it was based. It may be recalled that in his letter of dedication, WILLIAM promises to give the opinions of the " ancients " the emphasis that they deserve. It is extremely difficult to determine just how successfully this promise is fulfilled, as he very rarely cites authorities by name. Moreover the opinions for which he does give his source prove in most cases to be paraphrases of the original thought rather than accurate quotations. Hence it is frequently impossible to determine with absolute certainty the passage which he had in mind.

Further difficulty is created by the task of distinguishing between direct citations and those derived from intermediate sources. In some cases this is easily done. Thus, a reference to PITHAGORAS, (26) two citations from PORPHYRY, (27) four from ARISTOTLE, (28) four from PLATO, (29) and even seven passages from Scripture (30) can be shown conclusively to have been appropriated from an unacknowledged source which will be examined presently. On the other hand there is much uncertainty as to the directness of the citation from ALBUMASAR mentioned above. (31) If WILLIAM was an astrologer, it is likely that he

(26) Fol. 11 *v.*

(27) Fols. 15 *v.* and 24 *v.*

(28) Fols. 6 (here ARISTOTLE's name is a mistake for PLATO's); 17 *v.*; 20 *v.*; 44 *v.*

(29) Fols. 4 *v.*; 13; 24; 30 *v.*

(30) Fols. 6 *v.*; 7; 12 *v.*; 21 (two quotations); 38 (two quotations).

(31) *Supra*, p. 110.

was directly acquainted with a work of such importance as the *Introductorium in Astronomiam*. Yet the passage in question is repeated with great frequency by mediaeval writers. (32) Unfortunately comparison of the *Microcosmographia* with the *Introductorium* produces no very definite results, for the two works deal with quite different subjects. It is, however, possible that WILLIAM's carpings against the *medici* were inspired by ALBUMASAR's criticisms of the narrow medical men who ignore astrology. (33)

There is, on the other hand, no reason for questioning the directness of many of the citations. A definite reference to ARISTOTLE's *Topics* is above suspicion. (34) It is only natural that WILLIAM should have been acquainted with that fundamental treatise. Two other references to ARISTOTLE also seem to have come from this work. (35) A third is apparently taken from the *Categories*, (36) though it is possible that WILLIAM borrowed it from BOETHIUS. There is slight evidence of familiarity with Aristotelian material not in general circulation at the time at which the *Microcosmographia* was written. This is not to say, of course, that WILLIAM was not influenced by Aristotelian conceptions deriving from other sources than the *Organon*.

PLATO's name occupies a rather conspicuous position in the treatise. But the author's acquaintance with his works was certainly not extensive. Four of the references to him, as stated above, demonstrably come from an intermediate source. Of the remaining two, one is from the *Timaeus*. (37) The second is

(32) Cf. L. THORNDIKE, *History of Magic and Experimental Science* (New York, 1923), II, 703.

(33) *Opus introductorii*, Bk. I, ch. 5.

(34) Fol. 22 *v.*: "... unde ar. in topicis, sentimus nichil extra mittentes, sed intus aliquid suscipientes." Cf. *Topica* (English translation by W. A. PICKARD-CAMBRIDGE, Oxford, 1926), I, 14 (105 *b*).

(35) Fol. 36 *v.*: "Invidia, ut ait ar., est afflictio ex apparente prosperitate alicuius initium [inimicorum ?]." Cf. *Topica*, II, 2 (109 *b*); fol. 40: "... unde ait ar., delectioni que est in circulum quadrando nichil opponitur." Probably a paraphrase of I, 15 (106 *a*).

(36) Fol. 10: "Sicut etiam quantitatis, ut ait AR., proprium equale et inequale." Cf. *Categoriae* (English translation by E. M. EDGHILL, Oxford, 1926), ch. 6 (6 *a*).

(37) Fol. 17: "Hoc etiam innuit plato ubi ait, elementum est quod videtur sine visu videntis, tangitur sine tactu tenentis....". Cf. J. WROBEL, *Platonis Timaeus interprete Chalcidio cum eiusdem commentario* (Leipzig, 1876), 52 A-B.

more difficult to trace. In all probability it was taken from CHALCIDIUS' commentary upon that dialogue. (38) Both these were available to WILLIAM and should have been at his elbow as he was writing. Yet they seem to have been very sparingly used. There is, to be sure, considerable Platonic philosophy in the *Microcosmographia*, but it seems to have reached WILLIAM through devious intermediate sources rather than directly through the genuine Platonic writings at his command.

There is no reason for challenging a single reference to ST. AUGUSTINE. The opinion cited is apparently based on a passage in the *De Genesi ad litteram*. (39) Nor is there cause to doubt WILLIAM's acquaintance with BOETHIUS whose authority he twice invokes. On the first occasion he clearly has in mind the commentary on ARISTOTLE's *Categories*. (40) On the second, he specifies definitely the *De Consolatione Philosophiae* as his source. (41) An isolated quotation from the *Commentarium in Somnium Scipionis* of MACROBIUS seems likewise to be above suspicion, (42) as do the quotations from HORACE and VIRGIL. The former is named but once. The verse quoted is a well-known one from the *Epistulae*. (43) He is, however, quoted a second time without due recognition, the verse in question having been taken from the *Ars Poetica*. (44) VIRGIL appears to have been a peculiar favorite of WILLIAM, for he is cited eight times.

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(38) Fol. 5 *v.*: "Item, ut ait plato, principales partes anime sunt ratio et intellectus." Cf. CHALCIDIUS' commentary, ccxiii.

(39) Fol. 12 *v.*: "Videtur autem velle contrarium augustinus dicens, credendum animam hominis creatam fuisse cum angelis et naturalem voluntatem habuisse descendendi ad corpus." Cf. MIGNE, *P. L.*, XXXIV, 368-369.

(40) Fol. 10: "Sed etiam figura omnis incorporea est, ut omnes philosophi dicunt, quia qualitas est, ut ait boecius." Cf. MIGNE, *P. L.*, LXIV, 251.

(41) Fol. 13: "... quod nobis innuit boetius in libro de consolatione, ubi per mutationes sociorum ulixis sordidas morum nostrorum mutationes verissime effingit." Cf. *De Con. Phil.*, ed. H. F. STEWART and E. K. RAND (London, 1918), IV, 320.

(42) Fol. 4 *v.*: "... unde ait macrobius, neque enim is es quem corpus istud declarat. Sed mens cuiusque is est quisque." Cf. *Com. in Som. Scip.*, ed. F. EYSSENHARDT (Leipzig, 1893), Bk. II, ch. 12.

(43) Fol. 36: "... unde oratius, sperne voluptates, nocet empta dolore voluptas." Cf. *Epist.*, I, ii, 55.

(44) Fol. 19 *v.*: "Segnius irritant demissa per aurem quam que sunt oculis subiecta fidelibus." Cf. *Ars Poet.*, 180-181.

Six of the quotations prove to come from the *Aeneid*. (45) One comes from the *Eclogues;* (46) one is erroneously attributed to VIRGIL. (47)

Judged by the works and authors actually cited in his *Microcosmographia*, WILLIAM fails to be impressive. Yet he does neither himself nor his sources justice. The works which helped him most are nowhere mentioned in his pages. Possibly this was not deliberate dishonesty. The author may have believed that the prospectus in his letter of dedication constituted due and sufficient acknowledgment of his debts to others. Nevertheless, tested by modern standards, he was guilty of the most unscrupulous plagiarism.

Not once does he mention CICERO. Yet careful examination of his treatise proves that the great MARCUS TULLIUS assisted him in more ways than one. Many of his well-turned phrases emit a genuine Ciceronian ring, though it is not always possible to determine the source of inspiration. But it is more than a case of studied or subconscious imitation. Evidence of actual cribbing is by no means lacking. Thus, on at least three occasions, with no acknowledgment whatsoever, WILLIAM borrowed passages from the *Tusculan Disputations* for the adornment of his own pages. (48) The *De Amicitia* was treated in like fashion, though

(45) 1. Fol. 4 *v.*: " Item virgilius, sancta ad vos anima atque istius inscia culpe, descendam tantorum haut unquam indignus avorum." Cf. *Aen.*, XII, 648-649.

2. Fol. 7: " ... ut summus ille poetarum virgilius qui ait, hic vir hic est tibi quem promitti sepius audis." Cf. VI, 791.

3. Fol. 10 *v.*: " ... unde virgilius, sanguineam vomit ille animam." Cf. IX, 349.

4. Fol. 10 *v.*: " ... et alibi, vitam cum sanguine fudit." Cf. II, 532.

5. Fol. 10 *v.*: " ... unde idem virgilius, et vitam dispergit in auras." Cf. XI, 617.

6. Fol. 10 *v.*: " ... et alibi, nos iuvenem exanimum et nil eam celestibus ullis debentem vano mesti committamur honore." Cf. XI, 50-51.

(46) Fol. 7: " ... et alibi, iam nova progenies celo descendit ab alto." Cf. *Eclog.*, IV, 7.

(47) Fol. 9 *v.*: " ... unde ait virgilius, et mortis imago sompnus." This should have been CICERO rather than VIRGIL. Cf. *Tusculan Disputations*, I, 38, 92.

(48) Fol. 3: " Quid enim dulcius studio litterato? Hiis dico litteris quibus infinitatem rerum comprehendimus....". Cf. *Tusc. Disp.*, V, 37, 105.

Fol. 13 *v.*: " Item videmus quod homo in extremo tempore vite sue serit arbores et plantat... eos ad mortem obtandam vel saltem minus moleste ferendam induceret." Cf. I, 14-15, 32-33.

Fol. 20 *v.*: " Aristotiles autem super ista quatuor corpora quintam quandam essentiam finxit, quam endelichiam appelavit." Cf. I, 10, 22. See also the quotation which WILLIAM attributes to VIRGIL, *supra*, n. 47.

to a less extent. (49) Similarly BOETHIUS seems to have assisted him more than he cares to admit. (50)

Yet the most flagrant illustration remains to be noted. The work in question is in fact the key to the *Microcosmographia*. Not only does it appear to have been the source of WILLIAM's inspiration, but it aided him in countless practical ways. From it he derived the organization of his own treatise. From it he lifted bodily many of his references to ARISTOTLE and to PLATO, as well as the citations of PITHAGORAS, PORPHYRY, and Scripture noted above. From it he did not even scruple to borrow entire pages of text. Much of his own discussion is commentary upon the leading ideas of this unacknowledged source.

The work thus shamelessly pilfered was the *περὶ φύσεως ἀνθρώπου* of NEMESIUS, an obscure archbishop of Emesa who flourished in the late 4th and early 5th centuries. (51) Written originally in Greek, it was first translated into Latin ca. 1086, by ALFANO, bishop of Salerno. (52) This translation is usually cited as the *Premnon Physicon*. Somewhat later, in 1158, a second and more literal translation was made by the celebrated BURGUNDIO OF PISA, who dedicated the fruit of his labors to the Emperor FREDERICK BARBAROSSA. (53)

Which translation did WILLIAM use? Comparison shows beyond a doubt that it was the earlier one, the *Premnon Physicon*. In every case the *Microcosmographia* adheres closely to the

(49) For example, fol. 18 : " Nichil enim appetentius rapaciusque similium sibi est quam natura." Cf. *De Am.*, XIV, 50. His conclusion was probably borrowed from this same source, fol. 43 : " Hic habui que de microsmographia tibi scriberem." Cf. XXVII, 104. It may, however, have come from *De Senectute*, XXIII, 85.

(50) For example, fol. 31 : " Loquens enim a rebus sensibilibus ad intellectus et naturas earum procedit; a natura vero et intellectu ad voces, tanquam instrumenta intellectuum; audiens vero a voce ad intellectum, et ab intellectu ad ipsam rem sensibilem." Apparently this is a paraphrase of *Commentaria in Librum de Interpretatione, editio secunda*, in MIGNE, *P. L.*, LXIV, 404.

(51) On NEMESIUS, see W. SCHMID and O. STÄHLIN, *Geschichte der Griechischen Literatur*, part II (Munich, 1924), 1488 ff.

(52) On ALFANO, see M. MANITIUS, *Geschichte der Lateinischen Literatur* (Munich, 1911-), part II, 618-637. Translation published by C. BURKHARD, *Nemesii Episcopi Premnon Physicon* (Leipzig, 1917).

(53) Published by C. BURKHARD, *Gregorii Nysseni (Nemesii Emeseni) περὶ φύσεως ἀνθρώπου liber a Burgundione in Latinum translatus*, in *Programme des Carl-Ludwig-Gymnasiums* (Vienna, 1891, 1892, 1896, 1901, 1902).

phraseology of ALFANO and diverges sharply from BURGUNDIO's. A few typical instances, chosen at random, will make this clear. Thus :

Microcosm., fol. 3 *v.*	BURGUNDIO, I, p. 14.	ALFANO, I, p. 5.
"Constat hominem ex anima intelligibili et corpore tam bene compositum esse ut nequaquam oportuerit eum aliter fieri vel consistere."	"Hominem ex anima intellectuali et corpore (constare) optime constructum et ita bene, quod non conveniebat aliter genitum esse, multis et sapientibus viris visum est."	"A multis et prudentibus viris confirmatum est hominem ex anima intelligibili et corpore tam bene compositum, ut nequaquam oportuerit eum aliter fieri vel consistere."
Microcosm., fol. 4 *v.*	BURGUNDIO, I, pp. 14-15.	ALFANO, I, p. 6.
"Cunctis manifestum est animam corpore digniorem esse, ab hac namque movetur corpus tamquam instrumentum, quod mors demonstrat, separata namque anima, immobile remanet corpus omnino et absque opere, velud semoto artifice immobilia remanent instrumenta."	"Sed et aliter principaliorem corpore animam omnibus hominibus esse in confessione deductum est. Ab hac enim ut organum movetur corpus. Ostendit autem hoc mors; separata enim anima immobile manet corpus omnino et inoperabile, ut artifice separato immobilia eius manent organa."	"Sed et aliter digniorem corpore animam esse cunctis hominibus manifestum est. Ab hac namque movetur corpus ut instrumentum, quod mors demonstrat. Separata namque anima immobile remanet corpus omnino et absque opere, ut semoto artifice immobilia manent instrumenta."
Microcosm., fol. 32 *v.*	BURGUNDIO, XXXII, p. 100.	ALFANO, XXXIII, p. 117.
"Sed et aliquis subito videns amicum suum delectatur voluntarie, et sine preelectione, et aliquis insperatum thesaurum inveniens, illum quidem voluntarie lucro sibi apponit, sed non preeligens."	"Sed et amicus nobis repente astitit, voluntarie quidem, ut laetemur, non tamen eligentes. Sed et qui thesaurum inopinate invenit, voluntarie quidem eo fortunatus est, non vero eligens."	"Sed et amicus nobis subito praesentatus est, voluntarie quidem, ut delectaremur, sed non per praeelectionem. Et thesaurum insperatum inveniens voluntarie quidem lucro apposuit, sed non praeeligens."

The proportions of this debt to NEMESIUS might tempt one to dismiss the *Microcosmographia* as a worthless fraud. To act thus hastily would, however, be a serious mistake. Despite the frequency of his borrowings from the works of others, WILLIAM, as already intimated, does on occasion use his plunder as a basis for commentary or criticism of his own. In general, it may be said that he leans most heavily upon NEMESIUS when he treats of purely psychological matters. And even here his attitude is not invariably deferential. When, however, he finds reason to

discuss the phenomena of the natural world, he demonstrates a high degree of independence. No doubt he considered himself, as *physicus*, well qualified to speak on such topics. Thus, while NEMESIUS affords him the opportunity to discuss the four elements, WILLIAM actually goes far beyond his source, discussing such subjects as shooting stars, thunder, and lightning. These are not even mentioned in the *Premnon Physicon*. Similarly he expands NEMESIUS' rather brief treatment of the five senses into a lengthy analysis, in which the problems connected with sight receive particular attention. On such occasions he displays considerable hardiness of criticism, and here he is to be seen at his best. For these reasons it seems worth while to attempt to summarize the contents of the *Microcosmographia*.

Like NEMESIUS, WILLIAM opens his treatise with the assertion that man consists of an intelligent soul and a body. (54) But, he asks, does the soul possess intelligence *(intellectus)* naturally and of itself, or is it acquired from without? This question is suggested, though not very definitely answered by NEMESIUS. WILLIAM is more positive, if less discreet. To all appearances, he argues, intellect is an acquired faculty. As some creatures possess it in higher degree than others, it must be quantitatively present in the soul. It cannot, therefore, be of the substance of the soul, but must be an accident. Moreover, unless intellect is found in every creature, it cannot be substantially of the soul, since souls created without it would be imperfect. Yet there is certainly reason to suppose that some souls lack intellect for a long time after their creation. A year—old child, for example, seems to have less intellect than a dog of the same age, and certain animals, because of their keenness of sense, appear even more intelligent than old men. But despite the cogency of his own arguments, WILLIAM does not conclude that the soul is created without intellect. Instead he discovers a correct answer to the problem in the view attributed by NEMESIUS to ARISTOTLE. According to this, in nature and potentiality intellect is created equally in all men. Differences are in act only. Those who apply themselves earnestly to good disciplines develop it to a very marked degree; those who are more sparing of themselves

(54) Fol. 3 *v*.

fail to do so. Thus it is that some men are even more brutish than the very brutes.

For a proper understanding of such problems, continues WILLIAM, it is essential to understand the relative position of man among created beings. Accordingly, beginning with irrational creatures, he proceeds to sketch the Aristotelian *scala naturae*. (55) Though most of this is taken directly from NEMESIUS, a rather interesting discussion of animal intelligence seems to be his own. (56) Certain animals, he observes, such as dogs and monkeys, seem clearly to imitate man. Hence some writers have held them to be endowed with reason. Yet this is quite impossible. Since animals are entirely corporeal, they can participate in corporeal activities alone. Moreover, they do not possess souls, and hence they cannot have reason. Reason is the product of training or natural genius and animals lack these. Finally, reason resides in the middle cell of the head, and animals lack that cell. He does not bother to explain how he became aware of this deficiency. The seeming intelligence of animals, he asserts, is due to a kind of memory. This is proved by the fact that in order to make them perform it is necessary to give them some definite signal, a movement of head or body, or some inarticulate exclamation. Were they rational, articulate words alone would suffice. WILLIAM's arguments sound exceedingly naive to modern ears. But in denying the rational faculty to animals, he was in substantial agreement with most writers of his time. (57)

Returning from this digression to the ascending scale of nature, WILLIAM at last reaches man, the truly rational being. (58) Yet even man, though possessed of reason, intellect, and sense perception at the beginning of life, does not have perfect command

(55) Fol. 5 ff.

(56) Fols. 5 *v.*-6.

(57) ADELARD OF BATH seems to doubt whether animals possess reason, but he does not deny them souls. Cf. his *Questiones naturales* (Louvain, ca. 1480), cap. 13. See also: HUGO OF SAINT-VICTOR, *De unione corporis et spiritus*, in MIGNE, *P. L.*, CLXXVII, 287-288; WILLIAM OF SAINT-THIERRY, *De natura corporis et animae*, *ibid.*, CLXXX, 702; ROGER BACON, *Opus majus*, ed. J. H. BRIDGES (Oxford, 1897), II, 7 ff. BACON, however, attributes to animals a faculty akin to reason. He also allows them a "middle cell."

(58) Fol. 6.

of them at once. Sense perception is weak until reason and intellect are sufficiently developed to use it as a tool. But this requires time, and for a period the human soul is deficient in sense perception as well as in intellect and reason. This provides an explanation of the remarkable sense perfection of animals. In them, sense is not, as it is in man, a tool of the soul. It exists for its own sake. The entire energy of brutes is concentrated in sensing. The energies of the human soul, on the contrary, are divided, being partly engaged in judging non-sensibles through reason and intellect, and partly employed in reacting to the data provided by sense perception. It is slight wonder, then, that certain animals are sensually more acute than men.

Man's position among creatures, concludes WILLIAM in the words of NEMESIUS, is an intermediate one. (59) He has attributes in common with both the higher and the lower orders of being. He combines the rational with the irrational, the corporeal with the incorporeal. Yet he represents more than a combination of these faculties, for God through Christ, whose coming was foretold even by the pagan philosophers, added his own nature to the human. (60) Here follows a lengthy declamation on the exalted status of man, in which it is duly proved that all things were expressly created for his benefit. (61) Nearly every word is taken from NEMESIUS.

WILLIAM next proceeds to examine the views of various philosophers on the nature of the soul. These too are provided by NEMESIUS. The independent material is scant and unimportant. The most notable digression is a brief discussion of traducianism, in which WILLIAM finds a certain plausibility. Yet ultimately he rejects it as untenable. Similarities between children and parents, he observes, derive from the body only, just as water poured into a vase assumes the taste of its container. (62) He then turns to the Christian theory of the soul, scrutinizing the formula, *animam infundendo creari et creando infundi*. He points out numerous difficulties consequent upon such a hypothesis.

(59) Fol. 7.
(60) *Ibid.*
(61) Fols. 7 *v.*-9 *v.*
(62) Fol. 12.

Most of them are suggested by NEMESIUS, but he is able to propose a few of his own. Yet instead of driving his arguments home, he loses courage and concludes with a tame *tucius est hec credere quam opinari, et subtilius contempnere talia quam solvere.* (63)

Even now he has not finished his discussion of the soul. From Christian doctrine he passes to the Platonic teaching of a world soul, which is briefly explained by NEMESIUS. WILLIAM criticizes this conception rather sharply, arguing that if there were a world soul, there would be soul in every material body, *quod inconveniens est dicere.* (64) Again, since an infinite number of material objects undergoes corruption and dissolution every hour of the day, the souls of such bodies must pass to other bodies, and so a single object might have several souls at one and the same time, *quod est absurdum dicere.* (65) The transmigration of souls, which, naturally, he rejects, and his arguments in support of immortality may be passed over as all of his points are derived from CICERO or NEMESIUS. His own conclusion as to the soul is the perfectly safe one, *quod substantia est incorporea et immortalis habens principium et carens fine.* (66)

Despite the space devoted to the nature of the soul, WILLIAM has been able to contribute painfully little of his own to the discussion. Nor does he do much better in the lengthy treatment of the union of body and soul, which follows. Little of it diverges more than a hair's breadth from the corresponding section of the *Premnon Physicon.* When he turns to the body, however, he finds himself on more familiar territory and WILLIAM the natural philosopher is enabled to assert himself.

In the Middle Ages any treatment of the human body could hardly avoid some discussion of the four elements. Upon such a discussion WILLIAM straightway embarks, following in general the accepted ideas of his age. Even here, NEMESIUS is by no means discarded, but much of this portion of the treatise derives from other sources. Although he is nowhere mentioned, CONSTANTINE THE AFRICAN was in all probability among them. ADELARD OF

(63) Fol. 13.
(64) *Ibid.*
(65) Fol. 13.
(66) Fol. 13 *v.*

BATH and WILLIAM OF CONCHES may likewise have proved useful to WILLIAM.

He begins by defining an element as *simpla et minima pars confectionis corporis.* (67) Thence he proceeds to demonstrate that an element is a body, a body *non simplex, immo simplum, id est unius solius generis.* He then cautions his readers, as do so many mediaeval writers, against the assumption that the sensible objects vulgarly known as earth, water, air, and fire are the elements themselves. (68) Rather should these be spoken of as elemented *(elementata).* "Quomodo, enim, essent ista elementa, cum quodlibet eorum in aliud resolvatur, ut quod modo est terreum, cras fiat aqueum; aqueum, aereum; aereum, igneum?" Each of the so-called elements in reality contains all four of the genuine elements, though one is always more abundantly present than the others. After further elaboration of this point, he goes on, as does NEMESIUS, to demonstrate how each element is linked to two of the others through the agency of common qualities. Thus water which is cold and wet is bound by the former quality to earth; by the latter to air. Earth in its turn, being not only cold but also dry, is linked to fire. So, in circular fashion, the elements are held indissolubly together.

These ideas were available to WILLIAM in numerous sources and to them, it must be admitted, he added nothing of his own. But in the application of the hypothesis he seems to have been more logical and consistent than were most of his predecessors or contemporaries. The conception which appears to have impressed him particularly was the generation of one element from the corruption of another, for he takes considerable pains to remind the reader of the proofs of such transitions in the world about him. The watery, subject to evaporation, he points out, becomes mist, then cloud, and eventually passes over into the

(67) Fol. 16 *v.* Cf. CONSTANTINE THE AFRICAN, *De elementis,* in *Summi in omni philosophia viri Constantini Africani medici operum reliqua* (Basel, 1539), pp. 4-7: "Philosophi diffiniunt simplam et minimam compositi corporis particulam esse elementum." See also WILLIAM OF CONCHES, *De philosophia mundi,* in MIGNE, *P. L.,* CLXXII, 48-49.

(68) Cf. ADELARD OF BATH, *op. cit.,* cap. 1; WILLIAM OF CONCHES, *loc. cit.,* 50-51; DANIEL OF MORLEY, *Liber de naturis inferiorum et superiorum,* pub. by K. SUDHOFF in *Archiv für die Geschichte der Naturwissenschaften und der Technik,* VIII (1918), 19.

airy. But if the airy becomes too heavy from the exhalation of moisture into it, the process reverses itself, the airy passing back into the watery, a transition which manifests itself in the form of rain. (69) Now exactly the same phenomenon occurs when the airy passes over into the fiery. If the exhalations from the former become too frequent and too heavy, the latter is weighted down or saturated and is finally re-transformed into the airy. This explains such fiery manifestations as falling stars and the images in the sky vulgarly known as demons or serpents. There is a common cause for all these, simply the transition of the fiery into the airy. Actually they take place in the day as well as at night, though they are visible at the latter time only. (70)

WILLIAM's most interesting application of the transmutation of the elements is found, however, in the following detailed explanation of thunder and lightning : (fol. 19).

Quandoque autem huius transitio non sine magna vi et crepitatu maximo, qui dicitur tonitrus, habet fieri. Post nimios enim solis calores, aer calefactus et omnino arefactus, et hoc maxime post meridiem, usque adeo quod propter carentiam humoris totus fuliginosus appareat, terram et aquam quibus contiguatur calore suo aporiat humoremque ab eis elicit. Et in tantum ea caloris sui commixtio irritat, ut necessario in nubes terra et aqua evaporent, sicut ferrum candens vel tegula, si luto vel alii humido admoveatur, facit illud fumum exalare. Quanto vero maior precesserit calor, tanto maiores sunt maris exalationes densioresque efficiuntur nubes, eoque magis ad terram vergentes, arcuanturque circa terram in modo crepidinis excludunturque a nobis superiores fines aeris siccissimos. Quia vero aque abintus evaporando moventur, omnem vero motum aque comitatur ventus, exalationes cum quodam flatu et vento ascendunt. Quia vero nubes longe sursum propter sui ponderositatem ascendere non possunt, prope terram distenduntur. Ventus vero, tum ex sui mobilitate, tum conductu superioris ignis ad sui fomentum et recreationem inferiorem aerem iam humefactum attrahentis, usque ad extremos fines aeris siccissimos, immo usque ad ipsum ignem diverberat tantoque directius quod a mari et aquis diametricaliter suppositis sursum procedit. Sicut ergo videmus in ignis sufflatione, quod aer ab ore animalis missus et temperate humefactus in seque magis constrictus, utpote cum maximo hiatu intra fauces tractus et inclusus (fol. 19 *v.*) et per minimam fissuram labiorum cum maximo conamine naturalium instrumentorum colatus, quod etiam fit artificialiter per flatile instrumentum, aer, inquam, ille consonante motu et verberatu super carbonem cadens, si prope admota fuerit sicca materia, ut stupa vel etiam lignum siccum, ignitur et fit flamma alligans sese supposite materie. Et si continuaverit spiritus flans, augescit flammam duplicaturque sonus. Sonat enim aer flatus, tonat et flamma mota. Haud secus aer ille motus super crepidinem nubium, id est, ventus usque ad supremum ignem diverberans cum magno sonu et crepitatu.

(69) Fol. 18 *v.*
(70) *Ibid.*

Quia prope est sicca materia, id est, aer multum dessiccatus, cito ignitur et fit flamma. Flamma vero iterum per flatum continuantem mota, multo cum maiore crepitatu movetur fitque tonitrus daturque ei nomen a sono, qui etiam nobis expresse representatur flatu flamme ignis. Ibi autem maior resultat sonus propter crepidinem nubium interpositam. Aer ergo ille ignitus per tenuitatem nubium, licet densarum, statim a nobis videtur appellamusque coruscationem fitque simul tonitrus. Prius tamen videtur ignis quam audiatur tonitrus. Velocior enim sensus est visus quam auditus et certior, ut postea ostendemus, iuxta illud, "Segnius irritant demissa per aurem, quam que sunt oculis subiecta fidelibus." Quia vero aer ille superior adhuc nimis siccus est, unde facile accenditur, facile etiam extinguitur sicut stupa, et tunc transit igneum in aereum. Inde est quod non in singulis coruscationibus fulgur aut fulmen habemus. Quando vero paulo (fol. 20) plus humectatus est superior aer, tunc ignitus habensque plus aque ad fomentum ignis non statim extinguitur, sed humore pregravante ad inferiora vergit aeremque movens ventum generat. Flamma enim non sine vento movetur extinguiturque persepe antequam ad nos veniat, vel propter nimis celerem motum suum, vel propter ventum ab eo generatum, sicut vides lucernam que nimis cito portatur vel de loco ad locum iactatur, extinguitur vel propter humiditatem aeris inferioris iam per pluviam madefacti. Crebro tamen ita prope nos extinguitur, quod inpetus venti ab eo generati usque ad nos dilabitur turresque et campanilia ceteraque eminentiora edificia diruit, arbores consternit, ligna plerumque in clitellas secat. Si vero aer superior magis et magis humefactus crebra per flatione iterum ignitur plurimum habens materie fomenti, plurimum fervescit. Nec facile extinguitur, licet descendat ad inferiora uritque omnia que invenit, donec paulatim ex frigiditate aeris et collisione sibi obviantium calorem suum diminuit evanescitque iterum ignis et transit in aerem, quod propositum est monstrare. Illa vero materia aeris que ignita descendit per superfluam ustionem ad similitudinem cotis vel lapidis indurescit recipiturque vel intra terram, vel intra aquam, vel supra terram relinquitur iuxta impetum fulminis prius demissi, ideoque maxima fulmina non in principio tonitrus sed post aliquantulum pluvie continuationem solent venire. His igitur monstratum sit igneum corpus transire in aereum....

From earliest times man has sought the explanation of such spectacular meteorological phenomena as thunder and lightning. But neither in Antiquity nor in the Middle Ages could natural philosophers agree as to their cause. Most of the hypotheses advanced by the Ancients attributed thunder to the roar of wind bursting through a cloud in which it had been imprisoned. Lightning was generally admitted to be fire, generated according to some, by the rays of the sun, according to others, by the friction of the wind as it rent the enveloping cloud. Still others laid it to the friction of the clouds striking and rubbing each other. (71) Such views were transmitted to the Middle Ages by PLINY, SENECA, LUCRETIUS, and other intermediaries to reappear in pure or modi-

(71) For the opinions of the Greeks, see O. GILBERT, *Die meteorologischen Theorien des Griechischen Altertums* (Leipzig, 1907), pp. 619-638.

fied form in the works of such encyclopedists as ISIDORE OF SEVILLE, THE VENERABLE BEDE, and RABANUS MAURUS. (72) The more scientifically sound theory of ARISTOTLE which regards thunder as the result of the ejection of the dry exhalation of earth from the enveloping moist exhalation of water, though extant in SENECA's *Quaestiones naturales*, (73) received little attention until the recovery of the Stagirite's scientific treatises in the late 12th and the 13th centuries.

Certainly there was wide divergence of opinion in the 12th century. While the more conservative natural philosophers continued to accept ISIDORE, BEDE, and RABANUS, the more inquisitive sought for other and more satisfactory explanations. Thus ADELARD OF BATH propounded the ingenious if naive theory that water vapor rising from the earth is eventually frozen into ice. When this is broken up by head winds or by the heat of summer, a crash results which we call thunder. Lightning is fire forced out of the ice by the crash. (74) WILLIAM OF CONCHES, on the other hand, found an explanation of thunder in the clashing together of the winds. Moist vapor in rising exerts a downward pressure which sets the upper airs in motion and they clash together like waves of the sea. Lightning results from the heat generated in this violent agitation. (75)

The author of the *Microcosmographia* presents a theory containing unusual, if not unique, features. Like ADELARD OF BATH and WILLIAM OF CONCHES, he ascribes to evaporation a fundamental role in the production of thunder and lightning. But in many respects his ideas are quite different from theirs. Lightning to him is but a manifestation of the transmutation of the elements. Thunder is simply the roar of wind and flame combined. At least this theory has the virtue of consistency. It is decidedly less artificial than that of ADELARD or that of WILLIAM OF CONCHES.

(72) ISIDORE, *Etymologiarum libri XIII*, in MIGNE, *P. L.*, LXXXII, 476-477; BEDE, *De natura rerum*, *ibid.*, XC, 249-251; RABANUS, *De universo libri XXII*, *ibid.*, CXI, 277.

(73) Bk. II, xii.

(74) *Op. cit.*, chs. 64-68.

(75) *De phil. mundi*, *loc. cit.*, 78-79. Cf. also K. WERNER, "Die Kosmologie und Naturlehre des scholastischen Mittelalters mit specieller Beziehung auf WILHELM VON CONCHES," in *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften* (Vienna), Phil.-Hist. Cl., LXXV (1873), 362 ff.

It is true that he repeats the old tale that the material of lightning is hardened into a stone. It will be noted, however, that he does not consider this the thunder-bolt. To him the destructive power of lightning is wind. No doubt WILLIAM OF CONCHES displays sound common sense in denying the existence of any such stone. The later WILLIAM defers in this particular to popular tradition, but at least he relegates the stone to a purely incidental position in the principal phenomenon.

From this lengthy digression WILLIAM returns to the elements. Assisted by NEMESIUS, he is able to reject the Aristotelian fifth element, which, he remarks, is called *endelichiam*. (76) He also refutes the claim that there is but a single element, and proves, to his own satisfaction at least, that the number of elements is necessarily four.

Eventually he reverts to the human body, the topic which called forth this discussion of the elements. As his remarks are practically all taken from NEMESIUS, they need not detain us. The subject leads, however, to a detailed consideration of the five senses in which the *Premnon Physicon* is left far behind. Of peculiar interest is the following discussion of sight : (fol. 23 *v.*)

Quid sit visus et unde fiat.

Primo queritur quid sit visus, de quo diverse fuerunt sententie, hoc tamen prius notato, quod *visus equivoce dicitur*. (77) *Appellatur enim visus sensibilis virtus ; dicitur etiam visus sensus*, scilicet virtus sensibilis cum instrumento quod est oculus. Quidam autem dixerunt visum esse quosdam *radios ab oculis usque ad terminos visibilium extensos* et *velud manus exterioribus corporibus in tactu adiunctas, ut suscipiant visibilia tanquam manus tangibilia*. (78) Sed hoc esse non potest. Si enim radii illi extenduntur usque ad terminos rei visibilis, et hoc cum mora aliqua, (79) citius deberent venire ad proxima quam ad remota. Citius ergo debemus videre quidlibet ante nos positum quam nubes, que remotissime sunt, quod non accidit. Item, radii illi ignei sunt. Vis enim ignea est qua (fol. 24) videmus. Sed ignis naturaliter tendit ad superiora, levis enim nature est, nec umquam descendit nisi coactus. Ergo radii naturaliter tendunt ad superiora. Ergo omne animal debet videre superiora, quod non accidit in brutis. Item, si

(76) Fol. 20 *v.* See *supra*, note 48.

(77) Italics indicate borrowings from NEMESIUS.

(78) Attributed by NEMESIUS to HIPPARCHUS. Cf. BURKHARD, p. 75.

(79) In assuming that the passage of light requires time, William diverges from the commonly accepted view of his age. See S. VOGL, " Roger Bacons Lehre von der sinnlichen Spezies und vom Sehvorgange," in *Roger Bacon Commemoration Essays*, ed. A. G. LITTLE (Oxford, 1914), p. 221.

hoc est, saltem facilius debemus videre superiora quam inferiora, quod falsum est. Immo difficilius videmus. Item, si hoc est, quanto aliquid propinquius est oculis, radii illi melius et perfectius possunt illud attingere, et ita melius potest videri, sicut fit in tactu. Quod factum est adeo, quod si nimis proximetur visibile (m) oculo, omnino non videtur. *Plato* vero adiecit, dicens radios ab oculis venientes *per collatum* sibi *splendorem aeris a sole illuminati* adiuvari, quem idem error eademque culpa confundit. Eandem enim sententiam secuntur predicta et alia. Videmus enim multa terrestria animalia videre sine omni commertio aeris, vel illuminati, vel non illuminati, ut bufones, qui in aere vivere non possunt, et tamen vident. Similiter pisces in aqua vident, nec indigent aere. Immo in aere exibiti et visum et alios sensus amittunt. Item, secundum hoc acutius debent videre animalia in aere illuminato quam obscuro, et ita melius in die quam in nocte. Quod in tanto non accidit, quod quedam animalia subtilius et acutius in nocte vident quam in die, ut murilegi. Alii vero imagines apparentium oculis tanquam speculis advenire aiebant. (80) Sed si hoc est, ergo sicut unum solum corpus duabus resultat imaginibus in duobus speculis continue positis, ita omnis corporis apparentis due debent imagines duobus oculis advenire. Ergo nobis aliquod corpus videntibus, debemus nobismet videri videre duo, sicut accidit uno oculorum a directione alterius (fol. 24 *v.*) parum emoto, quod pueri solent facere. Item, cum solis imago plene cadat super speculum, multo citius super oculum cadere debet, quia est materie lucidioris, quod falsum est. Solem enim nemo potest intueri nisi mane vel vesperi, vesperi tamen minus, quia magis purificatus est et siccatus aer. Item, cum luna existente iuxta solem etiam infra. XXX. gradus, quando scilicet a nobis videri non potest, eius ymago speculo adveniat in eoque videatur. Quare similiter oculo non advenit, cum sint eiusdem nature? *Porfirius in libro de sensualitate ait, visum nec esse radium, nec imaginem vel idolum rei vise, sed animam se ipsam cognoscentem in visibilibus substantiis.* Sed si hoc est, in omnibus visibilibus est anima omniaque corporea sunt animam cohabentia, et ita animarum, alia rationalis, alia irrationalis. *Aristoteles* autem, magis proximans veritati, ait, *qualitatem mutationis aeris in circuitu existentis a visibilibus ad visum accedentem* esse causam visus. *Tale enim instrumentum videndi nobis est exterius aer, quale interius nervus sensibilis a cerebro natus,* (81) *per quem spiritus animalis ad exteriora rotatur.* Aer namque corporeis substantiis per colorem assimilatus solisque vel ignis splendore illuminatus, immo quasi animatus, liquidam illam partem oculi cui adheret nervus sensibilis contingit resultatque in eo tanquam in speculo. Nervo vero contacto tactuque ipso permutato, aerem illum in oculi luciditate resultantem suscipit spiritus animalis in nervo existens (fol. 25) *diiudicatque et discernit principaliter colorem et per colorem formam et quantitatem et locum et circomstantias omnes exteriores rei vise.* Quod etiam accidit in speculo et in qualibet alia lucida materia, quod aer corpori iuxta se posito per colorem assimilatus luceque aliqua vegetatus materiam lucidam sibi appositam contingit resultatque in ea per illius liquiditatem. Unde sicut in aere illo resultante discernimus et colores et quantitates et alia exteriora corporum in directo speculi existentium, ita in

(80) Cf. BURKHARD, p. 76 : " Epicurei autem idola, hoc est imagines, apparentium advenire oculis aiunt."

(81) A view attributed by NEMESIUS to GALEN. WILLIAM dose not seem to realize that his arguments against the Platonic theory of sight would apply equally well here.

oculo ea ipsa que ab eo videntur, si ex directo ei opponamur. *Quod autem aer propinquantibus* vel remotis *corporibus* colore *assimiletur, patet quia accedente aliquo rubeo* vel viridi corpore, *sive splendente ut argenteo et luce* aliqua *presente*, ut radio solis vel lucerna alia, a colore illius *illato* sibi *convertitur* et permutatur *aer*, ita quod apparet permutatus super aliquam materiam oppositam etiam non lucidam. Huius etiam certissimum est argumentum, quod visus defatigatus aspectu viridis herbe revirescit, quod, quomodo posset fieri nisi colore ad ipsum accedente? Hoc etiam magis accedit, quod ex aspectu cuiusdam generis herbarum color faciei ipsius aspitientis reviviscit. Quod accidere non potest, nisi color herbe ad faciem accedat eique alliniatur, vel aer eo colore infectus vi eiusdem coloris et infectionis colorem ab interioribus super faciem trahat. (82) Aer igitur coloribus corporum infectus illuminatusque luce aliqua oculo spirituique in eo contento *ad cognitionem visibilium organum existit, tale quale est nervus* spiritusque visibilis (fol. 25 *v.*) et *cerebro* et animali. Licet autem aer ille, sic formatus, sic luci unitus, ambos oculos contingat, tamen ex duobus contactibus unus solus sensus, id est visus, efficitur, quoniam oculi recta linea ordinati sunt et locati. Si vero supprimas vel deprimas digito alterum oculorum, quoniam eum iam continget alius aer et alii luci unitus erit, efficientur duo visus videberisque tibi ipsi duo videre. Idem accidit in tactu. Cum enim digiti instrumenta sunt tangendi, si corrupto ordine naturali postponas posteriorem priori in tangendo, cancellando unum super alium tangasque utroque lapillum aliquem, videberis tibi duos tangere. Et hoc fit propter naturalis ordinis permutationem. Tactus enim linetarius dispositus est in digitis manuum, ut visus est in oculis. (83)

The striking feature of this discussion of sight is WILLIAM's preference for the Aristotelian doctrine that the eye is solely a receiving instrument. (84) Most of the ancients and practically

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(82) Somewhat suggestive of a passage in the *Ten Books on the Eye* of JOANNITIUS (ḤUNAIN IBN ISḤĀQ). Cf. " Galeni de oculis a Demetrio translatus," in GALEN's *Opera* (Venice, 1586), " Libri Septimae Classis," cap. 6, p. 188 *v.* See also M. MEYERHOF and C. PRÜFER, " Die Lehre vom Sehen bei Ḥunain b. Isḥāq," in *Archiv für Geschichte der Medizin*, VI (1912), 32. There were two Latin versions of the *Ten Books on the Eye* current in the 12th century, one translated by CONSTANTINE THE AFRICAN, the other by an obscure DEMETRIUS. See J. HIRSCHBERG, " Über das älteste arabische Lehrbuch der Augenheilkunde," in *Sitzungsberichte der Preussischen Akademie der Wissenschaften*, 1903, pp. 1080-1094.

(83) LUCRETIUS refers to this method of producing double vision. Cf. *De rerum natura*, Bk. IV, 447 ff. GALEN, PTOLEMY, and many others discuss the problem. See A. BJÖRNBO and S. VOGL, " Alkindi, Tideus, und Pseudo-Euclid : Drei optische Werke," in *Abhandlungen zur Geschichte der mathematischen Wissenschaften*, XXVI (1910-12), 92 and n. 1. The passage is somewhat reminiscent of one in ARISTOTLE's *Problemata* (English translation by E. S. FORSTER, Oxford, 1927), 959 *a*. This work does not, however, appear to have been available in Latin until the 13th century. Cf. SARTON, *op. cit.*, II, 829, 860.

(84) For theories of vision in Antiquity and the Middle Ages, consult the following : J. HIRSCHBERG, *Geschichte der Augenheilkunde*, 2nd ed. (Leipzig,

all of WILLIAM's European contemporaries were hostile to that theory and insisted that the eye emits rays. (85) This hypothesis had several variant forms, the most common being that of PLATO, elaborated and popularized by GALEN. According to it, the rays coming from the eyes mingle with the light coming from the external objects to produce sight. It was only in the Saracen world that the Aristotelian view found much support in the early Middle Ages. And here such notable thinkers as JOANNITIUS (ḤUNAIN IBN IṢḤĀQ, d. 877) and ALKINDIUS (AL-KINDĪ, d. ca. 873) rejected it. But RHAZES (AL-RĀZĪ, d. 923-924), the Brethren of Purity (Ikhwān al-ṣafā', 10th century), AVICENNA (IBN SĪNĀ, d. 1037), ALHAZEN (IBN AL-HAITHAM, d. 1039), and AVERROËS (IBN RUSHD, d. 1198) were its defenders. (86) In the 13th century Europe too became more favorably disposed towards it, owing to the recovery of the Aristotelian scientific and psychological treatises and to the translation into Latin of many of the works of these great Saracen philosophers. Yet the theory that the eye emits rays was very slow in giving ground. Though ALBERTUS MAGNUS and WITELO rejected it, ROBERT GROSSETESTE and ROGER BACON sought anxiously to reconcile it with the Aristotelian

1908), in *Graefe-Saemisch Handbuch der gesamten Augenheilkunde*, XII and XIII; E. WILDE, *Geschichte der Optik* (Berlin, 1838), I; E. WIEDEMANN, "Zur Geschichte der Lehre vom Sehen," in *Annalen der Physik und Chemie*, Neue Folge, XXXIX (1890), 470-474; M. MEYERHOF and C. PRÜFER, "Die Lehre vom Sehen bei Ḥunain," *loc. cit.*, pp. 22-23; L. BAUR, *Die Philosophie des Robert Grosseteste* (Münster, 1917), in *Beiträge zur Geschichte der Philosophie des Mittelalters*, XVIII, Heft 4-6, 111, note 2.

(85) See, for example, ADELARD OF BATH, *op. cit.*, cap. 23; DOMINGO GUNDISALVO, *De divisione philosophiae*, ed. L. BAUR, *Dominicus Gundissalinus de divisione philosophiae* (Münster, 1903), in *Beitr. z. Gesch. d. Phil. d. Mittelalters*, IV, Heft 2-3, 113-114, also 257; WILLIAM OF CONCHES, *De phil. mundi.*, *loc. cit.*, 96; WILLIAM OF SAINT-THIERRY, *De natura corporis et animae*, in MIGNE, *P. L.*, CLXXX, 705; HUGO OF SAINT-VICTOR, *De unione corporis et spiritus*, in MIGNE, *P. L.*, CLXXVII, 287; ALEXANDER NECKAM, *De naturis rerum*, ed. T. WRIGHT (Rolls Series, London, 1863), pp. 237-238; ALANUS DE INSULIS, *Anticlaudianus*, in MIGNE, *P. L.*, CCX, 521.

(86) The position of ALPHARABIUS (AL-FĀRĀBĪ) is doubtful. WIEDEMANN, "Zur Geschichte der Lehre vom Sehen," *loc. cit.*, and BAUR, *Die Phil. d. Robt. Grosseteste*, *loc. cit.*, classify him as a defender of the Aristotelian view. Yet GUNDISALVO who closely follows ALPHARABIUS' *De scientiis* in his *De divisione philosophiae* holds a ray theory. Cf. BAUR, *Dominicus Gundissalinus de div. phil.*, *loc. cit.*, pp. 256-257.

view. (87) It is said to have had defenders as late as the 18th century. (88)

How is WILLIAM's position on this controversial matter to be explained? Was his advocacy of the Aristotelian theory dependent upon sources which he failed to acknowledge, or was it simply and purely the outcome of personal observation? On the whole, the second alternative is the more probable. There is no evidence that he had at his disposal such treatises of ARISTOTLE as the *De anima*, the *De generatione animalium*, and the *De sensu*. Nor is there reason to suppose that he had seen works of Saracen supporters of ARISTOTLE, though certain of them were apparently available in Latin at the time at which he was writing. Thus AVICENNA's *Liber sextus naturalium* (part of the Kitāb al-shifā') had been translated by JOHN OF SEVILLE and GUNDISALVO as early as 1150. (89) It is even possible that ALHAZEN's great *Opticae thesaurus* (Kitāb al-manāẓir) was to be had in Latin by 1178. (90) There is, however, little suggestive of the mature reasoning of such writers in the rather jejune arguments propounded by WILLIAM. Similarity is evident only in the general conclusions.

For the most part, then, WILLIAM's partiality for ARISTOTLE must be credited to his independence rather than to his learning. After all, his explanation of vision is in most of its details substantially that of GALEN. Only the conception of the eye as a sending instrument is lacking. Possibly his ideas were influenced by a careless reading of JOANNITIUS' *Ten Books on the Eye*. The naive refutation of opposing theories, the inconsistency of many

(87) For ALBERTUS, see *Liber de sensu et sensato*, Tract. I, caps. 7-8, ed. BORGNET, IX, 13 ff.; for WITELO, C. BAEUMKER, *Witelo ein Philosoph und Naturforscher des XIII. Jahrhunderts* (Münster, 1908), in *Beitr. z. Gesch. d. Phil. d. Mittelalters*, III, Heft 2, 129 and 615. On GROSSETESTE, see BAUR, *Die Phil. d. Robt. Grosseteste*, *loc. cit.*, p. 111; on BACON, VOGL, "Roger Bacons Lehre von der sinnlichen Spezies," *loc. cit.*, pp. 225-226.

(88) C. SINGER, "Steps Leading to the Invention of the First Optical Apparatus," in his *Studies in the History and Method of Science* (Oxford, 1921), II, 392.

(89) M. STEINSCHNEIDER, "Die europäischen Übersetzungen aus dem Arabischen bis Mitte des 17. Jahrhunderts," in *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften* (Vienna), Phil.-hist. Cl., CXLIX (1904), 42, no. 68.

(90) STEINSCHEIDER considers the attribution of the translation of this important work to GERARD OF CREMONA doubtful. Cf. *loc. cit.*, pp. 23, 82. In the *Introduction* to vol. II (p. 23) SARTON attributes it definitely to GERARD. It does not, however, appear in his list of GERARD's translations, pp. 339-344.

of his leading contentions, the neglect of the functions and structure of the eye, the total absence of mathematical demonstration, bespeak WILLIAM's lack of contact with the scientific knowledge which was already trickling into Europe from the Greek and Saracen world. This does not mean that he had completely escaped its influence. Yet his acquaintance with the new material was certainly slight.

At the same time his interest in optics was clearly more than casual. From sight itself he passes on to various problems related with it, such as color and form, quantity and quality, the limitations of sight, its dependence on memory and the other senses. Here he simply reproduces the thought of NEMESIUS. Soon, however, he digresses once more to enquire why images do not appear in glass, crystal, and ice as they do in mirrors. (91) He points out that though these materials are lucid bodies, they are fine *(subtilia)* and of loose texture *(rara)*. Moreover, they are like air in substance and color, and sight is unable to distinguish between objects which are alike in these qualities. Glass, because of its looseness of texture, does not retain the illuminated air which falls upon it. This may be shown by holding a mirror behind a piece of glass. The air passes right through the glass and the image of an object on the other side of it appears in the mirror. This fact is clear even to the man in the street *(vulgo)*, who sees the rays of the sun shining through a stained glass window and bringing with them the color of the glass. That glass and water are unable to resist illuminated air is further proved by the fact that the color of objects on one side or the other of the glass or water is brought to the eye of an observer standing on the opposite side. But with a mirror, or a piece of steel *(calibe)*, or other smooth bodies *(corpora levigata)* it is different. The air is unable to penetrate them because of their solidity, and so remains upon their surfaces just as it would on those of a stick or a stone.

This problem suggests still another, the age old one of why a straight stick partly immersed in water appears to be bent. (92) Apparently WILLIAM was quite ignorant of refraction. Water,

(91) Fols. 26 *v.*-27.
(92) Fols. 27-28.

he says, because of its corporeal and liquid nature moves only downward or in a plane. It never moves upward. Hence it is always flat. But since it is impossible for form to appear without a solid, an object under water must take on some similarity to that solid by which it is presented to the vision. Wherefore, water being flat, the image of an object in water looks flat. For this reason even round objects under water look flat, and so it is with the stick. The part in the water seems to be lying flat, while the part in the air is upright. The clouds, too, are of a liquid and watery nature and likewise have a flat position. For this reason sun, moon, and stars look flat to us, though actually they are globular in form. So also in glass. If a bulge *(ventrum)* be made in the middle of a piece, an object seen through it will appear to have a bulge or cone in it. But the air, which is no more moved in length and breadth than up and down, brings objects to our eyes just as they are. Thence he proceeds to mention a number of optical illusions, but all of them are taken from the *Premnon Physicon*.

WILLIAM's treatment of the other four senses is briefer and more perfunctory than his discussion of sight. Touch, taste, and smell are disposed of by a few verbal borrowings from NEMESIUS. Hearing receives more detailed attention, but there is little worthy of note in WILLIAM's remarks. Hearing, he asserts, unlike sight, does not sense in a straight line, but all around. Thence he goes to some pains to prove that voice or sound is corporeal. He illustrates the propagation of sound by the simile of the stone thrown into a pool of water and setting in motion wider and wider circular ripples, a much over-worked comparison in the Middle Ages. (93)

From the senses WILLIAM turns to other functions of the soul. He treats them at considerable length, but as practically all of this portion of the treatise is drawn from NEMESIUS it deserves only superficial attention. Only the order in which topics are treated is somewhat altered. Amplifications or criticisms by the author himself are few and far between.

(93) See, for example, ADELARD OF BATH, *op. cit.*, cap. 21; ALBERTUS MAGNUS, *Liber II de anima*, Tract. III, cap. 19, ed. BORGNET, V, 267; *Isagoge in libros de anima*, cap. 8, *ibid.*, 515; *Liber de apprehensione*, part 2, *ibid.*, 568. Possibly the origin of the simile was VITRUVIUS, *De architectura*, V, III, 6.

After barely mentioning the *virtus fantastica sive imaginatoria* which is common to rational and irrational beings, he proceeds to consider the properties of the soul using the body. One of these is the *virtus memorativa* under which he discusses memory and recollection. (94) A second is the *virtus discretiva*, which he divides between rational and irrational movements. As rational he classifies, with NEMESIUS, *scientia veri et falsi, notitia boni et mali, cognitio iusti et iniusti, scientia mechanica, divinitio, premeditatio, consilium et liberum arbitrium.* (95) He devotes some space to each of these, but it is to the last three that he gives particular attention. Thence he turns to the irrational movements, distinguishing between those obedient to reason and those non-obedient. (96) Of the former, he discusses pleasure *(delectatio)*, desire *(desiderium)*, pain *(afflictio)*, fear *(timor)*, and anger *(ira)*. Under the latter, he includes the natural functions of the body, such as the nutritive *(nutribile)*, generative *(generativum)*, and the pulsative *(pulsativum)*. (97) He leaves the discussion of these, however, to his enemies, the doctors. Finally he takes up the properties common to the soul and the body. (98) He classifies them as voluntary and involuntary. After some attention has been paid to each class, he brings the treatise to a somewhat abrupt conclusion with the words, *Hic habui que de microsmographia tibi scriberem. Tuum ergo erit opusculum istud, quod tibi vovi, examinare et de his que tibi gratis contulimus grates condignas referre. Valete.*

Such is the *Microcosmographia*. Its influence upon its own or later times seems to have been nil. The only extant copy appears to be that contained in the MS. of Trier. Nor, as far as I am aware, is it cited by any mediaeval writer. The causes of its obscurity are not far to seek. Unfortunately, in dealing with the microcosm, WILLIAM had to subordinate his interests in the natural world to the problems of psychology. But, as has been indicated, his psychology leans too heavily upon a single source. Had NEMESIUS been a writer unknown to the learned

(94) Fol. 30 *v.*-31 *v.*
(95) Fol. 31 *v.*
(96) Fols. 34 *v.*-37.
(97) Fol. 40 *v.*
(98) Fols. 40 *v.*-43.

world of the 12th century, WILLIAM would be entitled to nothing but praise for making available material which in itself is of genuine value and significance. Such was by no means the case. The translations of the *περὶ φύσεως ἀνθρώπου* were well known to his contemporaries. Indeed it appears to have been a standard treatise on matters psychological. Thus, JOHN OF SALISBURY in his *Metalogicon* recommends it to his readers. (99) WILLIAM OF SAINT-THIERRY incorporated much of it into his *De natura corporis et animae*, (100) as did HUGO ETERIANUS into his *Liber de anima corpore iam exuta*. (101) A mediaeval reader versed in the psychological literature of his day could have found little in the *Microcosmographia* to arouse his interest or hold his attention, even if he were not sharp enough to detect the plagiarism.

Actually WILLIAM's forte was not psychology. It is the sections of his treatise dealing with thunder, lightning, and optics which lend him significance. And even here he represents, for the most part, the old science which was already being displaced by the new material from Sicily and Spain. Nevertheless his eclecticism is in itself significant of the state of mind which made the reception of Greek and Arabic science possible, and should entitle him to a position among the natural philosophers of the renaissance of the 12th century.

Whether his treatise ought to be considered a " survival of the school of Chartres," as Prof. HASKINS believes, (102) depends somewhat upon the point of view. WILLIAM's partiality for the Latin poets and his scientific interests do indeed suggest such affinities. So also does the fact that the treatise is dedicated to a former bishop of Chartres. On the other hand, WILLIAM displays little of that deference for PLATO customarily associated

(99) Lib. IV, cap. 20. See, also, HASKINS' review of WEBB's edition of the *Metalogicon*, in *Eng. Hist. Rev.*, XLV (1930), 296-297, and WEBB, " Notes on John of Salisbury," *ibid.*, XLVI (1931), 262.

(100) Compare, for example, MIGNE, CLXXX, 695-696 with NEMESIUS (Alfano), *Prologus*, and cap. V, 15, 40-41; 696 B with cap. XXIII, 8 ff.; 707 B with cap. VIII, 5 ff.

(101) MIGNE, *P. L.*, CCII, especially 173 A-175 D, 184 B-187 A. HUGO's phraseology does not seem to be either that of ALFANO or of BURGUNDIO. As he knew Greek it is not improbable that he was using the treatise in its original form.

(102) *Op. cit.*, p. 91.

with the school of Chartres. To be sure, his work contains a considerable leavening of Platonic conceptions, but this is the eclectic Platonism of NEMESIUS. As already noted, the *Timaeus* seems to have had very little influence upon him. If anything, WILLIAM seems to take peculiar pleasure in showing PLATO to have been in error, as he does in dealing with the various theories of sight. His intellectual affiliations remain, therefore, an open question.

Perhaps it would be charitable to refrain from scrutinizing too closely his motives in composing the *Microcosmographia*. Possibly they were ingenuous. WILLIAM may have been sufficiently conceited to believe in his own ability to answer the riddles left unsolved by the "ancients." It is difficult, however, to avoid the suspicion that he was writing primarily with an eye to attracting the attention of a munificent patron. But, *requiescat in pace!*

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Chemical arts in the Mount Athos manual of Christian Iconography

1. The object of the present communication is to give a systematic account of the chemical information contained in a treatise called the *Mount Athos Manuscript*, the interest of which from this point of view was very briefly pointed out by RHOUSOPOULOS (in DIERGART, *Beiträge aus der Geschichte der Chemie*, dem Gedächtnis von G. W. A. KAHLBAUM, Leipzig and Vienna, 1909, 174).

The MS. was discovered in 1839 in the course of a journey through Greece by the elder DIDRON and PAUL DURAND, who noticed that the religious paintings in the various churches were all done after the same pattern, as though "one thought had inspired a hundred brushes." The source of the tradition was discovered in a visit to a cloister of the community of twenty monasteries, representing the various nations belonging to the Greek Church, at Mount Athos, situated at the extremity of a long peninsula, crossed by the remains of a canal attributed to XERXES, and running into the sea from Chalcidice. Mount Athos (*Ἄθως* in HOMER), surmounted in antiquity by a colossal image of the Thracian ZEUS, has since 1048 A.D. been called the Holy Mountain (*τὸ Ἅγιον Ὄρος*) (V. LANGLOIS, *Le Mont Athos et ses Monastères*, Paris, 1867, 6 f.; A. S. NEYRAT, *L'Athos;* notes d'une Excursion à la Presqu'île et à la Montagne des Moines, Paris, 1880; H. BROCKHAUS, *Die Kunst in der Athosklöstern*, Leipzig, 1891, based on Greek text of 1853, see below). Here DIDRON and DURAND saw similar work in course of execution, and were shown a manual entitled *Ἑρμηνεία τῆς Ζωγραφικῆς*, a "Guide to Painting," which after some trouble DIDRON had copied. The cloister at Lavra contained a very old MS. of DIOSKORIDES (NEYRAT, 145).

The monasticism at Mount Athos is strict : a pious reverence for the Theotokos going with a ban, operating since CONSTANTINE MONOMACHOS in 1046, on all females on the peninsula, even of the animal kind, insects and fish being exempted as beyond control : eggs were imported and no milk was obtainable (LANGLOIS, 6; NEYRAT, 57, 59).

2. A translation of the work appeared in 1845 : *Manuel d'Iconographie Chrétienne grecque et latine* avec une introduction et des notes par M. DIDRON... traduit du manuscrit Byzantin *(sic)*, le guide de la peinture, par P. DURAND, Paris, 1845 : in spite of the title, the volume contains only the French translation, with no index, and very meagre notes on the technical part : it is referred to as *D.* below. A Greek text was published in 1853 : *Ἑρμηνεία τῶν ζωγράφων*. Athens, from a MS. brought by C. SIMONIDES (a second edition by KONSTANIDES, Athens, 1885, q. by RHOUSOPOULOS, in DIERGART, 1909, 174, and KRUMBACHER, *Geschichte d. byzant. Lit.*, in I. MÜLLER, *Handbuch*, Munich, 1897, IX, i, 1117, I have not been able to see). SIMONIDES' edition contains some sections not in other MSS. and has been suspected, since the editor was detected in the forgery of manuscripts (e.g. his *Uranii Alexandrini de regibus Aegyptiarum libri tres*, 1856; another publication of his is a 15 page pamphlet *Concerning Horus of Nilopolis*, London, 1863, i.e. on HORAPOLLO, SARTON, *Intr.* i, 358; cf. BROCKHAUS, 161). It contains (I, § 86, p. 54) a few alchemical verses : *περὶ χρυσοῦ λιθου κατασκευῆς* (... *Ἀδάμας καὶ πύριτης εἰς γῆς τὰ σπαλάγχνα μένων / Ἡμέρας ὀγδοήκοντα, κ' εἰς κάμινον βληθοῦν...*) of no interest, not in other editions. The section on photography (only invented in 1826 by DAGUERRE) in this edition is one of the accretions which the whole work has constantly received, and is no argument against the authenticity of the rest of the text (E. BERGER, *Beiträge zur Entwickelungs-Geschichte der Maltechnik.* Quellen und Technik der Fresko-, Oel- und Tempera-Malerei des Mittelalters, Munich, 1897, 10). The preface of the MS. used by SIMONIDES is dated 1458 (RHOUSOPOULOS, 174). The German translation by G. SCHÄFER : *Ἑρμηνεία τῆς ζωγραφικῆς* : *Das Handbuch der Malerei vom Berge Athos*, aus dem handschriftlichen Urtext übersetzt, mit Anmerkungen von DIDRON d. Aelt. und einigen

von GOD. SCHÄFER, Trier, 1855, is based on this text and DURAND's French translation and gives brief references to Greek " Fachwörter " in notes (mostly from DIDRON and DURAND) only. It was of no assistance to me.

A critical edition of the text appeared in 1909 : *Ἑρμηνεία τῆς Ζωγράφων Τεχνης* : *Manuel d'Iconographie Chrétienne*, accompagné de ses sources principales inédites et publié avec préface, pour la première fois en entier d'après son texte original par A. PAPADOPOULO-KERAMEUS, aux frais de la Société Impérial Russe Archéologique. St. Petersburg, 1909; 4to; preface (in modern Greek) pp. *α'-να'*; text pp. 1-351 + 1 unnumb. contents; Greek index 303-351. Referred to as *K* below.

This edition contains additional texts (pp. 237-301) as follows (i and ii drawn upon in the present account) :

(i) *Ἑμηνεία τῆς Ζωγραφικης τεχνης ... μέτρα καὶ χρώματα τοῦ Πανσελήνου* (pp. 237-253; largely reproducing the technical sections of the first part);

(ii) *Ερμηνεια της Ζωγραφικης του Τοιχου* (pp. 255-260; reproducing pp. 36-43 of main text, with an additional section);

(iii)—(v) Various theological treatises.

A paper by H. MACHT (*Ein Blick in das Handbuch der Malerei vom Berge Athos*, in Mitteil. d. österr. Museums für Kunst und Industrie in Wien, xi, N. F.). I have not seen.

3. None of the MSS. seen at Athos by DIDRON was as early as the 15-16 cent., and he recognised that the notes and additions of later craftsmen were incorporated in the text of each new copy, which the individual artist made for his private use. The supposed author calls himself in a separate preface DIONYSIOS OF FURNA, near Agrapha (*D.*, xxxv, 9), the " least of painters " and a follower of " the celebrated and illustrious master PANSELINOS OF THESSALONIKA, comparable with the moon in splendour " (*πᾶσα σελήνη*). The author professes to imitate this PANSELINOS (*K.*, 3; *D.*, 7), to whom some recipes are specifically attributed (*K.*, 20 f., 236 f., etc.; *D.*, 33; cf. NEYRAT, 100 f.), and DIONYSIOS was assisted by his pupil PHILIP OF CHIOS.

DIDRON (*D.*, xxxiii f., 7) dates PANSELINOS in the 12 cent. and the treatise itself in the 15-16 cent., but the latest view (*K.*, *θ'* f.; DIELS, *Abh. Königl. Preuss. Akad.*, Berlin, 1913, No. 3, p. 12;

KRUMBACHER, 1117; O. M. DALTON, *Byzantine Art and Archaeology*, Oxford, 1911, 250, 649 vacillating; COOKE, *Zeus*, Cambridge, 1925, ii, 138) is that DIONYSIOS lived early in the 18 cent. but used a work of MANUEL PANSELINOS, who lived in the 16 cent., or else an anonymous painter's book of 1566. BROCKHAUS (1891, 151, 158 f.) himself saw copies of the treatise dated 1630, 1787 and 1838, and assumed (ib. 161) that it was written in the 16 or first third of the 17 cent.; NEYRAT (op. cit., 102) dated it 16 cent.; HENDRIE (*An Essay upon Various Arts*, in three books, by THEOPHILUS, also called RUGERUS, Priest and Monk, ... London, 1847, 73, 99; the best text and translation of THEOPHILUS) thought the work as published by DIDRON and DURAND comprised material of the 12-16 cents., which may well be true.

The question of the antiquity of the work was examined by BROCKHAUS (op. cit. 158 f.) who considered : the heterogeneous character of the language, the first part (of interest to us) being in modern Greek; the omission of the Synods after the 8 cent., in line with the present day observance, whilst miracles and personalities up to the 14 cent. are included; PAUSELINOS is spoken of as living in the past. DIDRON (*D.*, xxiii) and LABARTE (*Histoire des Arts industriels au moyen âge et à l'époque de la renaissance*, 3 vols., Paris, 1872-75, i, 59) thought the treatise incorporated the work of Greek artists expelled from Constantinople in the 13 cent. by the Crusaders.

DIDRON (*D.*, xxii, xxvii f., xxxiv) arranged for the translation of the work by DURAND, who was assisted by several specialists, including MIALLE, professor of pharmacy in the Faculty of Medicine at Paris. A large part of the work (*D.*, 71-467) deals with artistic details, design, etc., and only Book I treats of materials (*D.*, 1-65) and is of interest to us. In our account the latest Greek text has been followed.

4. The work contains Turkish, Italian (*D.*, xxvii, xxviii, 8), German and Persian words, and the Levantine weight ocque (3 ½ lb. avoirdupois; HENDRIE, 74; *K.*, 13). It mentions the Muscovites (*K.*, 33, 34, 246; *D.*, 51; *Μοσχόβικα; Μοσχόβοι*) and Cretans (*K.*, 34; *D.*, 51). The Slav element in the population of the Peninsula appeared soon after Christianity was established in Russia, about 1000 A.D. (LANGLOIS, 7; SARTON, *Intr.*, i, 655).

DIONYSIOS says (*D.*, 8) that in his treatise he proposes to explain with great exactness all the measurements and characters of the figures, the colours of the flesh and ornaments, the proportions of the human body (*τὰ μέτρα εἰς τοῦ νατουράλιν*), the particular work for each subject, the different preparations of varnish (*βερονικίων τινῶν*), glue, plaster, and painting on walls; also the sequence of the Old and New Testaments, the manner of representing the natural and miraculous events in the Bible, the parables of our Lord, the legends, the texts belonging to each prophet, the names and character of expression of the apostles and principal saints, their martyrdon and a part of their miracles, in the order of the calendar. These promises he, in fact, fulfils.

A strict conformity to tradition in ecclesiastical art had been laid down by the Second Council of Nicaea in 787 (FINLAY, *History of the Byzantine Empire*, EVERYMAN ed., 69 f.) An echo of the bitter quarrels of the Ikonoklastes and Ikonodules appears in an appendix to the work (*D.*, 451): "we worship, not the colours and art, but the type... the real person... as ST. BASIL says, the honour paid to an image is addressed to the model... we thus act with wisdom in representing and honouring the sacred images."

DIDRON (*D.*, xxxiii, xxxv) considered that the technical part is of little present-day value, since the recipes are obscure or even unintelligible, and both the identification of the substances and the evaluation of the correct proportions are either difficult or impossible. Something may, however, be done in this direction. KERAMEOS in his preface (pp. *α'-λβ'*) refers to a number of works in modern Greek and Russian on the subject and (ib. *γ'*) mentions four MSS. of the treatise of the 18 cent. The same types of tradition, in some parts going back to Justinian and the building of the Hagia Sophia at Constantinople, or even in some recipes perhaps to DIOSKORIDES (EASTLAKE, *Materials for a History of Oil Painting*, 1847, 79) are represented, no doubt through the intermediary of Mount Athos, in Russian works such as the Podlinnik, which may be derived from Byzantine parchments: POLYCARP (12 cent.) mentions such a work as preserved in the cloister at Kiew: this treatise is different from the Mount Athos MS. and in some cases is more detailed; no recent study of it

seems to be available. Another Russian treatise is the Stoglaff of the painter RUBLEFF (14 cent.) which speaks of " the school of Athos, founded by PANSELINOS in the 11 cent." (BERGER, 69; BUSLAEV, *Russian Picture Apocalypses*, Moscow and St. Petersburg, 1884; SABATIER, *Notes on Sacred Iconography in Russia*, St. Petersburg, 1849; these works, in Russian, are not available to me, and the subject must be left to those acquainted with that language).

The Recipes in the Treatise

5. The recipes are arranged in a definite order, that of the execution of the work, and the whole is really a text-book rather than a mere portfolio of practical traditions (BERGER, 72). Weights are often specified, such as the drachm (*δράμια*; *K.*, 17 and often), and the Levantine ocque (3½ lb. avoirdupois; HENDRIE, 74).

5. A. *Metals.* There is very little on metals in the treatise, the recipes in this part dealing solely with the preparation of pigments made from them.

(*a*) Gold leaf (*καυκι τζινένιο*) is powdered by rubbing with thick gum with the thumb in a dish, filling the dish with water and decanting two or three times, finally putting the gold in a shell with gum (*K.*, 28; *D.*, 45). Gold is also powdered by mixing a piece of gold, e.g. a ducat (*φλωρίον*) with mercury and salammoniac (*τζαπαρικόν*), heating in a crucible till the mercury fumes away, then adding double the weight of sulphur (*ἡ τεάφη*), grinding on a porphyry (*ἐν μαρμάρῳ πορφυρῳ*) and heating strongly in a large crucible till the sulphur has disappeared in fumes; it is then ground on a porphyry with water and a little salt till it is like fine sand, well washed, and kept in a shell (*K.*, 44; *D.*, 64). Grinding on a " marble " or porphyry is frequently described (*K.*, 20 etc.; *D.*, 33, etc.) Gilt letters are painted with a liquid made by grinding white lead, mercury, tin (*κασσίτερος*), lead, silver and strong vinegar (*ὀξείδι δριμὺ*) on a " marble " (i.e. a stone; marble would be attacked)till it liquefies (*K.*, 29, 248; *D.*, 45). A mordant (*μουρδέντι; μουρδέντιον*) for gilding is made (*K.*, 23, 42, 43, 247, 258, 259; *D.*, 38, 62) from 30 parts of *σουλιγένι* (sal gemme ?; BERGER, 88, suggests sou+legno, under-

lay, but this is the whole preparation), 3 of ochre, 5 of shells (*ὄστρακον*), 1 of verdigris (*τζιγκιάρι*) and 1 of white lead ground dry on a marble. For gilding porous limestone, it is first impregnated with *λινέλι* (linseed oil). Glass, marble, leather, iron, copper and lead may be gilt; cloth must first be impregnated with glue. Naphtha may be added when a blue wall is painted with gold stars (*K.*, 43; *D.*, 63). Ampoli (*ἀμπόλι*) is a preparation (*K.*, 17 f., 20, 243 f.; *D.*, 29 f.) over which gold leaf is laid : it contains bole, ochre, lampezi (red lead), tallow, and mercury " killed " by rubbing with the fingers on the palm of the hand with ash of paper and saliva, or with soap or bile and white of egg (" killing " mercury with saliva and sulphur is in a 12 cent. Salernitan recipe : Giacosa, *Magistri Salernitani nondum editi*, Turin, 1901, 75; the operation was very important in certain Indian schools and formed the basis of the Rasezvara System : LIPPMANN, *Alchemie*, 1919, i, 438; B. MOOKERJI, *Indian Civilisation and its Antiquity*, Calcutta, 1928, 63 f.; Prof. LIPPMANN's statement, *op. cit.*, 444, that little was known of alchemy in India in ALBIRUNI's time is in need of some slight modification; see my *Everyday Chemistry*, 1929, 71). Gilt glass mosaics (*ψήφοις χρυσέοις*) (*K.*, 1; *D.*, 3 f.) were made according to a well known Byzantine tradition.

The bole (*βόλος*) or Armenian bole (*κιλερμενί*) for use in laying gold leaf etc. is best when it is not very red, and has white veins inside (*K.*, 17 f., 20 f., 40, 243 f., 257; *D.*, xxxiv, 30; a ferruginous earth; *βῶλος*, a clod).

(*b*) Silver (*ἀσίμι*) is made yellow by a yellow varnish (*K.*, 26, 253; *D.*, 42), or used to make amalgams for letters (*K.*, 29, 248; *D.*, 45; the name is probably the Greek *ἄσημος ἀργυρος* rather than Egyptian *asem*, electrum, which is used in the Leyden Papyrus X.)

(*c*) Mercury (*ὑδραργυρος*) is well known (*K.*, 18, 29, 31, 44, 243, 248, 250; *D.*, 30).

5. B. *Pigments and colours.* Many pigments and colours are described, some mineral, others of vegetable origin.

(*a*) *Black* (*μαύρην βαφὴν*) (*K.*, 9, 20 f., etc.; *D.*, 17) includes lampblack from resinous woods (*καπνός τοῦ δαδίου*) (*K.*, 40; *D.*, 59, fumée du bois gras), and charcoal (*κάρβουνα*) pencils are made by charring sticks of nut-tree or myrtle wood in a

covered pot; or by putting them, wrapped in paper, on a fire and then cooling in ashes (*K.*, 10; *D.*, 19). Tracing paper (*ἀνθίβολα*) is made by impregnating paper with unboiled sesame oil (*μπεζίριν ἄβρασαν*), rubbing with pumice stone, and drying in the shade (*K.*, 9; *D.*, 17). Ink (*μέλανος*; the old name for *carbon* ink is *μέλαν Ἰνδικὸν*, in the *Periplus*, not indigo : SALMASIUS, *Plinianae exercitationis*, 1689, 180, "Indian ink," really Chinese) is made as follows : one ocque (3½ lb.) of apple tree bark is soaked in 1½ ocques of water, exposed to the sun for a week or two, then boiled to half with 10 drachms of nut galls (*τρυφε κικκίδια*) and 15 drachms of vitriol (*καλακάνθι*), filtered, and 10 drachms of pure gum (*κομμίδι*) dissolved in the liquid by heating.

(*b*) White lead (*ψιμύθι* ; *ψιμύθιον*), including Venetian white and French white (*ψιμύθι Φραντζέζικον*) in pastilles, is made by hanging pieces of lead over vinegar in a closed pot (*K.*, 9, 20 f., 31, preparation, 33 f., 243 f.; *D.*, 17, 33, 48); whiting is made from chalk or (also called *ψιμύθι*) from old lime which has become insipid to the tongue as earth (*K.*, 39; *D.*, 58; this is to prevent the action of the alkaline lime on the green lake used with it, BERGER, 86).

(*c*) Red lead is *λαμπέζι* (*K.*, 17, 243; *D.*, 30) or *κόκκινον μολύβι*, (*K.*, 243 ; *D.*, xxxiv) ; cinnabar (*ἡ κιννάβαρις*; *τὸ κινναβάρι*) (*K.*, 18, 20 f., 31, 41, 243 f., 250, 253, 257; *D.*, 31) is made by heating in a vase 100 parts of mercury (*ὑδραργυρος*) with 20 of sulphur and 8 of blood (useless, but supposed to improve the red colour), ground together (*K.*, 31, 250; *D.*, 47). Red (*κοκκινάδι*) is a colour of unspecified composition frequently mentioned (*K.*, 22, 40, 244, 257; *D.*, 60). Other reds and browns include umber (*οὔμπρα*; *οὔμβρα*) (*K.*, 20, 22, 40, 243, 245), and ochre (*ὤχρα*) of various shades, including that of Constantinople (*Πολίτικην*) and of Thasos (*K.*, 15, 17 f., 20 f., 34, 38 f., 42, 243 f.; *D.*, 30), also burnt ochre (*K.*, 22; *D.*, 36). The colour proplasmos (*προπλασμός*) (*K.*, 20, 21, 34, 39, 245, 257) appears to be a brownish-green, corresponding with the *prasinus* of THEOPHILUS (i, 2; HENDRIE, 3, 101); the mixture of umber and bole (*K.*, 20; *D.*, 34) perhaps corresponds with the *exudra* of THEOPHILUS (i, 13; HENDRIE, 11, 57); the flesh colour (*σαρκώνης*; *καμης σάρκα*) from Venetian white lead, ochre and cinnabar, is the *membrina* of

THEOPHILUS (i, 1; HENDRIE, 2) made in the same way; glykasmos (*γλυκασμος; γλύκασμα*) from 2 parts of flesh colour and 1 or less of proplasma (*K.*, 21, 22, 23, 40, 244, 245, 257) is the first *posc* of THEOPHILUS (i, 3; HENDRIE, 4, 400). Oxy (*ὀξὺ*) is a colour mixed with black (*μαυροξύ*) for touching up a flesh colour (*K.*, 20, 34, 38, 40, 41, 245; *D.*, 34): BERGER (73, 86) thought it was a violet ferric oxide (caput mortuum), corresponding with the second *posch* or *posc* of THEOPHILUS (i, 7; HENDRIE, 7, 100).

A crimson lake (*λάκκα κριμίζι*; *not* blue as BERGER, 79, thought; *azur* in medieval MSS. often means red, BERTHELOT, *La Chimie au moyen âge*, 1893, i, 200) is made by *τζουγας* (" drug "; BERGER, 79), filtering, heating with powdered *κριμίζι* (kermes; the dried female *coccus ilicis* insect, hence *carmoisin*, carmine) and ground loter (*λωτήρ; λωτούρ*; the bark of the *Symphococos racemosa*, KARABACEK, q. by BERGER, 79; ?). The liquid is stirred and powdered alum added. Filter (?) and allow the lake to settle out, taking out the liquid with a spoon and then by dipping in a moist cloth which " sucks off the liquid wonderfully " (capillarity). Then dry in the shade (*K.*, 29 f., 250; *D.*, 46). An azure (*λαζύρ*; perhaps here a *blue*) is made by boiling caustic lye (*q. v.*) with *τζιμαρίσμα* (? litmus; tournesol; orseille; in any case *not* woad, which does not give a lake, BERGER, 79), alum and white of egg (*K.*, 31 f., 251; *D.*, 48). Azure (*λαζοὺρι*) is sometimes crimson, occasionally blue (lapis lazuli?, azurite?, blue lake) (*K.*, 31, 32, 33, 40, 41, 42, 43, 251, 258, 259).

(*d*) Yellow arsenic (sulphide) (*ἀρσενὶκι*) (*K.*, 41, 258; *D.*, 61) must not be used for painting walls (since it reacts with lime). Another yellow is saffron (*κρόκος*; perhaps an ochre?; *K.*, 20, 243; *D.*, 33).

(*e*) Blues include lakes (see under *d*) and Persian blue (*λαζούρι Πέρσικον*; probably lapis lazuli) (*K.*, 33; *D.*, 51; E. DARMSTAEDTER, *Z. für Bücherfreunde*, 1929, 20). Indigo is perhaps included in *λουλάκι* (*K.*, 33, 40, 41, 245, 246, 247, 258; *D.*, 51, " indigo "; BERGER, 12, 80), although in the 8 cent. *Compositiones ad tingenda musivum*, lulacin is a blue lake made from blue flowers and alum (MURATORI, *Antiquitates Italicae medii aevi*, Milan, 1739, ii, 378; H. HEDFORS, *Compositiones ad tingenda musiva*, herausgegeben, übersetzt und philologisch erklärt, Inaug. Dissert., Uppsala, 1932, with a text, from the unique MS., startlingly different

from MURATORI's; lulakin is from the Sanskrit nīla, indigo, through the Persian nīlag, līlag, līlang; DIELS, in HEDFORS, 103).

(*f*) Among other greens (*K.*, 20, 243, 257) is a green lake (*πλάκα πράσινη*) (*K.*, 39; *D.*, 59; no details; BERGER, 86, suggests the green lake from mallow described by ERACLIUS, iii, 37, in Mrs. MERRIFIELD's *Original Treatises on the Arts of Painting*, London, 1849, i, 237; or the sap green, *succus*, of THEOPHILUS, i, 14, 15; HENDRIE, 12 f., 106; succus sambuci in THEOPHILUS is not a green, as BERGER says, but a purple). Verdigris (*βαρδάραμον i.e.* viridis aeris, vert de rame, verde rame, MERRIFIELD, ii, 917; HENDRIE, 102 ; BERGER, 101, 106 ; also *τζιγκιάρι*, *τζεγκιάρι*, *ζεγκιάρι*, Persian zengār, arabic zenjār, BERGER, 79) is made by setting pieces of copper stand in a closed copper pot containing strong vinegar and exposed to the sun (*K.*, 30, 33, 41, 42, 247, 249, 258; *D.*, 47 : it is *not* carmoisin, vermiculum, kermes, given by BERGER, 69).

5. C. *Acids, Alkalies and Salts.* The only acid mentioned is vinegar, including black vinegar (?) (*μαυρ' ὀξύ*; *K.*, 40; *D.*, 59, " bois noir "). A solution of quicklime in strong vinegar (*ὀξείδι δριμύ*) is boiled and then heated in hot dung for 36 days to make a solution (calcium acetate) for preparing azure (*K.*, 32, 251; *D.*, 49; if a copper blue is meant, the " new pot " in which it is kept must be a copper one, BERGER, 79;washing lapis lazuli may be meant). Aqua fortis (*δυνατὴ καταστάλακτή*) is not nitric acid but a filtered clear solution of caustic potash used for cleaning old pictures (*K.*, 27 f.; cf. 36, 39, 248 f., 251; *D.*, xxxiv, 43); although the author had successfully cleaned pictures in this way, another technician had removed all the colour, leaving a bare canvas, and so ruined the picture (*K.*, 27 f.; *D.*, 44).

A caustic lye is made by boiling quicklime (*ἀσβεστην ἄσβυστον*) with a lixivium (*στάκτη*) of oak ashes and letting the precipitate settle (*K.*, 31; *D.*, 48). Quicklime (*ασβεστος*) " as fat as lard," and free from unburnt stones, is slaked with water for painting walls (*K.*, 36, 37, 38, 251; *D.*, 56; a 12 cent. process, not true fresco, HENDRIE, 86 f., BERGER, 84). The method used at Mount Athos for painting on moist lime-washed walls is described by DIDRON (65 f.) : the colours at present come from France and Italy (ib. 68). Plaster is made by burning gypsum (*γύψος*) to

plaster of Paris, mixing 20 parts with 50 of water, then mixing with glue (*K.*, 13 f.; *D.*, 23 f.; Cennino's *gesso sottile*, BERGER, 73).

Salts mentioned include alum (*στύψις*) (*K.*, 29, 30, 250 f.; *D.*, 45), salammoniac (*τζαπαρικον*) (*K.*, 44; *D.*, 64) and vitriol, which is called *καλκάνθι* (not *βιτριόλον*, as in late Greek chemical MSS., PARTINGTON, *Nature*, 1931, 127, 158; the name *vitriolum* is fairly early but not classical, LIPPMANN, *Alchemie*, ii, 218, where some of the uses, however, are to the woad plant, vitrum, or the violet, not to vitriol : the *materials* were well known in the classical period, NIERENSTEIN, *Isis*, xvi, 439; a sympathetic iron-gall ink, not mentioned by NIERENSTEIN, is described by PHILO OF BYZANTIUM, 2 cent. B.C.; THEVENOT, *Veterum Mathematicorum Opera*, Paris, fol., 1693, 102) and is used in making ink (*K.*, 33, 253; *D.*, 50). Nitre is not mentioned, but neither is natron (soda), the only alkali being potash.

5. D. *Media for colours. Varnishes. Glues, etc.* Various types of media for colours are described.

(*a*) A medium for colours and gold giving brilliance is made by melting equal quantities of glue, white wax and potash solution (*κατασταλακτή*) (*K.*, 28; *D.*, 44; still used at Mount Athos). A mixture of snail slime (the preparation of which, by toasting the snail with a candle, is described), gum and alum forms a medium for gold (*K.*, 29, 248; *D.*, 45). The first medium, according to BERGER (*op. cit.*, 80), is closely related to the " Punic wax," made by boiling wax with salt water and nitrum (soda), and its use would then be a development of the ancient encaustic painting. I hope to show in a later communication that this is incorrect.

(*b*) Egg medium, as a natural product, was originally preferred to preparations with oil, in the Greek Church (BERGER, 69). BERGER (75 f.) has considered the use of egg medium in detail, and concludes that *αὐγόν* (*K.*, 9, 20, 23; *D.*, 17, 33, 38) is the whole egg; *λευκόν αὐγοῦ*, *λεύκωμα αὐγοῦ* and *ἀσπαδι αὐγοῦ* (*K.*, 18, 32; *D.*, 33, 49) are white of egg; yolk (*κορκός*) is not mentioned; even in the recipe for applying azure to dry walls (*K.*, 41; *D.*, 61), in which it is specified by THEOPHILUS (i, 16; HENDRIE, 17), it is replaced by paste (*πίτυρα*; *πίτερα*; *K.*, 9, 41,

42, 247, 258). BERGER (*op. cit.* 76) remarks that in the " Greek process " in THEOPHILUS for painting walls, yolk is replaced by white of egg (? objection to using the embryo in religious paintings). Besides egg, garlic or onion juice (for black and gilding) is used, also for transfers (*K.*, 9, 24; *D.*, 18 : it is an aqueous medium which adheres to oil, a well-known workshop trick, BERGER, 73).

(*c*) Gum (*κομμιδι*) is mentioned (*K.*, 28, 29, 33, 247, 248, 253), but no specific kind, as THEOPHILUS's cherry gum. Sugar candy (*κάντιον*) is well known (*K.*, 33, 253; *D.*, 50; cf. HEYD, *Commerce du levant*, 2 vols., Leipzig, 1885-6; ii, 680 f.; LIPPMANN, *Geschichte des Zuckers*, 1929, 100 f.). Glue (*κόλλα*) is made by boiling limed (*'Εργασμένα εἰς ἀσβέστην*) and de-haired skins, or skins from the feet and ears of oxen after liming, with water in a copper pot, skimming, evaporating till it gelatinises on cooling, cutting up, and drying in the air (*K.*, 11 f.; *D.*, 21 f.). Fish glue, which (including isinglass) is in THEOPHILUS (i, 30, 33) is not mentioned.

(*d*) Linon (*λινὸν*) (*K.*, 34; *D.*, 52) suggests linseed oil, as it is used in painting, but BERGER (88) suggests a mixed grey colour. Nut oil (*καρυδόλαδον*) is used for grinding with white lead (*K.*, 35, 246; *D.*, 54; cf. LABARTE, *Histoire des arts industriels au moyen âge et à l'époque de la renaissance*, 3 vols., Paris, 1872-5, ii, 153 f.; EASTLAKE, 30). Pezeri (*πεζίρι; μπεζίρι*) is used (*K.*, 14, 17, 24 f., 36, 42, 240 f., 251 f., 258; *D.*, 29) to make a ground for painting (HENDRIE, *Theophilus*, 98 f.), perhaps " stopping " (*πεσσὸν*; W. SMITH, *Latin-English Dictionary*, London, 1904, 823), a name still used by house-painters : DIDRON (*D.*, xxxiv) and BERGER (*op. cit.*, 73) say it is linseed oil, perhaps boiled, since " unboiled " pezeri is specified; SCHÄFER *(op. cit.)* calls it " Trockenfirniss." Pegula (*πέγουλα*) (*K.*, 24 f., 251 f.; *D.*, 40) is fir resin (turpentine) which has been heated in a copper pot till it ceases to froth (*φουσκώνοντας*), and is used for varnish (EASTLAKE, 249, " concrete turpentine ").

(*e*) Several kinds of varnish (*βερονίκι; βερονίκον; βερνίκιον); βερνίκι*) are described (*K.*, 23, 25 f., 36, 245 f., 252 f.; *D.*, 40 f.; HENDRIE, 63, 73), e.g. from pezeri, pegula, sandalwood (*?*) (*σανταλοζι*; " red wood," BERGER, 77), sandarach resin (*σανδρακα*; from *Thuia occidentalis Linn.*, BERGER, 77), aloes (*σαρισάμπρι; σαρίαμπρι*; perhaps really the resin of the aloe wood, lign aloes, from the tree *Aquilaria Agallochum*, CELSIUS, *Hierobotanicon, sive*

de plantis sacrae scripturae, 2 vols., Upsala, 1745-7, i, 135; BARTON, *Jewish Encyclop.*, i, 437; BALFOUR, *Cyclopaedia of India*, 3 ed., 3 vols., 1885, i, 38, 80, 122, etc.), dissolved in alcohol (*ρακί*) or naphtha (*νεφτι*; cf. *K.*, 43, 259) and sometimes filtered through a cloth. A thicker varnish is made from pegala and mastic (*μαστίχι*; *μαστίχη*) (*K.*, 25, 252; *D.*, 41).

(*f*) Alcohol (*τὸ ρακί*; *ἡ ρακή*, a Turkish name for alcohol, from the Arabic raqi, sweat, used for distilled spirit: ALDIMESQI, *Cosmographie*, tr. MEHREN, Copenhagen, 1874, 264, 271; "arrack"), used for laying on gold leaf and making varnish (*K.*, 18, 19, 20, 27, 242, 243; *D.*, xxxiv, 30 f.) is sometimes "four or five times distilled" (*K.*, 27; *D.*, 42; ? a Venetian recipe). The varnish is made by heating on an ash-bath 10 drachms of powdered sandarach and 5 drachms of pine resin with 10 drachms (?) of raki in a closed vessel. Two coats of such varnish may be put on with only a small interval between (for drying). A small glass of raki is still offered before soup in the monasteries (NEYRAT, 26).

Naphtha (*νέφτι*) is used as a medium for varnishes which dry in the shade (*K.*, 26, 43), for thinning boiled or thickened oil and for colours (*K.*, 26, 43; *D.*, 40, 54). Although the original meaning of *νάφθα* is petroleum, according to CHRISTOMANOS (q. by BERGER, 76 f.) this means oil of turpentine, not petroleum; *νάφτιον* or *νεφτι* in modern Greek means *τερεβενθίνη*, except in Zante, where it is the natural petroleum. This use of turpentine is thought by EASTLAKE (*op. cit.* 85) to be of 16 cent. Venetian origin, since the distillation of turpentine was perhaps discovered in Italy.

(*g*) Golipharpe (*γόλι φάρπε*) (*K.*, 27, 253), said to be used in Venice, is explained as "gold colour" (*χρῶμα χρυσόν*) and is in German (*γλῶσσαν τὴν ἀλαμάνικην*) "Gold-Farbe" (BERGER, 71, 77); it is not *aurum musivum* (PARTINGTON, *Isis*, 1934, 21, 203) but a ground for gold, a thick oil from the pot in which brushes are soaked (BERGER, *ibid.*). An 18 cent. dictionary of painting calls it "*or couleur*... du sédiment des couleurs qui se précipitent au fond de l'huile dans laquelle les peintres nettoyent leurs pinceaux" (*Dictionaire de peinture*, Paris, 1757; *or à l'huile*). It is already, as *Goldvarwe*, in a Strassburg MS., destroyed by fire as a result of the German occupation in 1870 but fortunately

available in a copy made for Sir C. E. EASTLAKE, now in the National Gallery, London (EASTLAKE, 126 f.; BERGER, 143).

5. E. *Miscellaneous.* Soap (*σαπούνι*) is used to mix with plaster (*K.*, 14, 17 f., 23, 36, 240 f., 242, 247; *D.*, 29). The paint-brushes (the preparation of which is described) are cleaned in unboiled pezeri (linseed oil), pressed, washed with soap or " strong water " (alkaline lye) and dried (*K.*, 36; *D.*, 55). A mixture of sawdust and glue is used for stopping worm-holes in wood, then covered with plaster or a cloth glued on (*K.*, 43; *D.*, 63). Tow (*στουππί*) is mixed with lime for plaster (to prevent cracking) (*K.*, 37; *D.*, 56; this use is mentioned by the architect L. B. ALBERTI, c. 1450, in his *De Re Aedificatoria*, BERGER, 83).

6. *Conclusion.* The chemical contents of the treatise are of small interest and are confined to the old processes described by PLINY, DIOSKORIDES and VITRUVIUS. In comparison with the treatises of ERACLIUS AND THEOPHILUS, the range of subjects dealt with is small. This may not be without its significance, as the more direct line of transmission of Byzantine technique, before the additions made by later writers appear, may be represented.

London, August, 1933. J. R. PARTINGTON.

Arabische Übersetzer und Kommentatoren Euklids, sowie deren math.-naturwiss. Werke auf Grund des Ta'rīkh al-Ḥukamā' des Ibn al-Qifṭī [1]

I

Die Kenntnisse der Araber auf den Gebieten der Mathematik und Naturwissenschaften gehen hauptsächlich auf griechische Quellen zurück. Die Verdienste der Griechen und Romäer wurden auch zu allen Zeiten von arabischen Gelehrten gewürdigt. So sagt Sā'ID (E. W., B. IX, 194), um nur ein Beispiel hier anzuführen, folgendes : „Die Romäer und Griechen wohnen in der Mitte der Erde und deshalb waren sie Gelehrte, welche die Dinge gründlicher als irgendwelche andere untersuchten, wie HIPPOKRATES und GALEN in der Medizin und in den natürlichen Dingen, wie ARISTOTELES und PLATON in den Verstandeswissenschaften und der Theologie, wie EUKLID und PYTHAGORAS in der Geometrie und in den exakten Wissenschaften und wie EUKLIMON (PALAEMON) und ILĀUS in der Physiognomik und den Vorzeichen."

In den Mittelpunkt meiner Ausführung stelle ich EUKLID, der von den Muslimen eine besondere ausserordentliche Verehrung genoss und bei deren mathematischen Betrachtungen geradezu die Grundlage bildete. Ein bekannter arabischer Gelehrter, namens ABŪ 'ALĪ (I. AL-QIFṬĪ, 411) berichtet von EUKLID : „EUKLID ist die Wissenschaft, mit der du zugleich das, was im Himmel und in den Ländern der Erde sich befindet, umfassest. Trotzdem man sie verwendet, wächst ihr Nutzen. O wie trefflich ist diese Einrichtung ! Er ist eine Leiter und seine Propositionen die Sprossen für den nächtlichen Wanderer zum höchsten Gipfel.

(1) Inaugural-Dissertation, Heidelberg, 1930.

Auf ihr steigt die Seele zum erhabenen Ort empor. Wie edel ist dieser erhabene Ort und der, der emporsteigt".

Meine Dissertation soll nun besonders zu jenen arabischen Autoren Betrachtungen anstellen, welche sich um die Werke EUKLIDS, sei es übersetzend oder sei es kommentierend, verdient machten. Hierbei stütze ich mich auf eine bereits schon im Jahre 1886 von M. STEINSCHNEIDER erschienene Arbeit des Titels "Euklid bei den Arabern" (*Zeitschrift für Mathematik*, etc., Histor.-liter. Abteilung, Bd. 31, 81-110). Von derselben erschien ein Kompendium desselben Autors, versehen mit einigen Berichtigungen und Ergänzungen, in der *Zeitschrift der deutschen Morgenländischen Gesellschaft (Z.D.M.G.)*, 50, 164-72, 1896.

Ich strebe nun eine Weiterführung und Ergänzung dieser Abhandlung im Sinne des Themas an, wobei mir vor allem eine ganze Reihe hervorragender Arbeiten von Gelehrten wie H. SUTER (†), C. SCHOY (†), E. WIEDEMANN (†), J. RUSKA, C. A. NALLINO, etc. zur Verfügung standen. Gerade bei Übersetzungen aus den Quellen konnte eine ganze Reihe von Begriffsdefinitionen, die in obigen Arbeiten zerstreut vorliegen und deren Zusammenstellung, obwohl noch unvollständig, äusserst verdienstvoll wäre, fruchtbar verwendet werden.

Ich legte meinen Ausführungen verwiegend die Quelle das I. AL-QIFTĪ (1) Ta'rīkh al-ḥukamā' (Chronik der Gelehrten) zugrunde und kam nur an solchen Stellen auf andere Quellen zu sprechen, wo es sich um eine bemerkenswerte Abweichung handelte. Ich benützte hierbei die Edition von J. LIPPERT (Leipzig, 1903). Den früheren Arbeiten der Gelehrten dieser Disziplin lag die Quelle des IBN AL-QIFTĪ in der lateinischen Übersetzung von 33 Biographien griechischer und arabischer Gelehrter von M. CASIRI in den „Arabico-Hispana Escurialensis opera", etc. Matriti MDCCLX vor.

In besonders kritischen Fällen werden wir immer der um ungefähr 300 Jahre älteren Quelle des IBN AL-NADĪM "Kitāb al-Fihrist" mehr Authentizität zusprechen müssen.

Ein vollständiges Verzeichnis der Quellen gibt uns H. SUTER in seiner Abhandlung "Die Mathematiker und Astronomen der Araber und ihre Werke" (Leipzig, 1900).

(2) Um das Lesen zu erleichtern, werden, in den bibliographischen Anweisungen, die Referenzen zu IBN AL-QIFTĪ durch *I. al-Qiftī* angegeben.

Bei der Aufzählung der Schriften der Gelehrten, die sich mit EUKLID befassten, wurden hauptsächlich nur die mathematischen und astronomisch-astrologischen berücksichtigt. Dass also auch die Astrologie Berücksichtigung fand, hat seinen Grund darin, dass sie zur Sternkunde sowohl bei den Griechen (PTOLEMÄUS) als auch bei den Arabern (AL-FĀRĀBĪ, IBN KHALDŪN etc.) gezählt wurde. Sie gehört somit den 'Ulūm riyāḍīya (math. Wissenschaften) an, welche, der aristotelischen Einteilung folgend, in vier grosse Unterabteilungen zerfallen, deren eine die Astronomie ist. Und gerade die Astrologie war es, welche zur Vervollkommnung der mathematischen Rechnungsmethoden führte. Auch fanden alle jene astrologischen Probleme Eingang in die Astronomie, soweit sie geometrischer, trigonometrischer und arithmetischer Natur waren. Besonders gefördert wurde die Astrologie und infolge dessen auch die übrigen mathematischen Wissenschaften begreiflicherweise an den Höfen von Sultanen und Chalifen, von welchen eine ganze Reihe hervorragender Observatorien gegründet wurden. Wo sich solche befanden, blühte auch das wissenschaftliche Leben. Astronomische Beobachtungen führten zu verwickelten Rechnungsmethoden, brachten eine Reihe höchst interessanter Probleme geometrischer, trigonometrischer Natur zur Diskussion. Der ausserordentliche Scharfsinn der muslimischen Astronomen führte zu Glanzleistungen in der Astronomie. Z.B. : Das Apogäum der Sonne macht die Nachtgleichen mit. Die Ekliptikschiefe zeigt eine langsam fortlaufende Abnahme, etc., was den Griechen unbekannt blieb.

Es wäre zweifellos höchst interessant, und das ist ja eigentlich die Forderung einer Geschichtschreibung, einen synthetischen Überblick über die Probleme der mathematischen Wissenschaft bei den Arabern zu geben. Mit welch ungeheuren Schwierigkeiten eine solche Lösung verbunden wäre — eine solche ist überhaupt erst in den Grundzügen möglich — braucht wohl kaum erwähnt zu werden. So bleibt meine Dissertation selbst nur eine Kompilation, welche aber immerhin geeignet sein mag, einen Hinweis auf die mit EUKLID sich befassenden muslimischen Gelehrten zu geben.

Wo ist eigentlich der Mittelpunkt der Pflege der Mathematik und Naturwissenschaften bei den Arabern zu suchen? Es ist Bagdad, welche Stadt im Jahre 145 (762) von dem zweiten 'abba-

sidischen Khalīfen AL-MANṢŪR (136-158 = 754-775) neugegründet wurde. Er nannte diese Stadt "Madīnat (Dār) as-Salām" d.h. "Stadt (Haus) des Friedens" (gr. *Εἰρηνόπολις*). Am Tage ihrer Grundsteinlegung standen „die Sonne im Löwen, der Merkur in der Ähre und der Mond im Schützen, ein glückliches Omen".

Drei 'abbasidische Khalīfen, AL-MANṢŪR, HĀRŪN AR-RASHĪD (170-193 = 786-809, der fünfte dieser Dynastie) und AL-MA'MŪN (198-218 = 813-833, der siebente 'abb. Khalīf) widmeten sich vorzüglich der Pflege der astronomischen Beobachtung, welche sekundär auch die Entwicklung und Vervollkommnung der mathematischen Methoden veranlasste. Übersetzungen, Kommentierungen sowie selbständige Arbeiten erfolgten in jenem Zeitalter. Durch die Übersetzung des Almagests (ḤAJJĀJ B. YŪSUF B. MAṬAR, ḤUNAIN B. ISḤĀQ, Revision des THĀBIT B. KURRA) wurde die geometrische Darstellung der Himmelsbewegung in die muslimische Astronomie eingeführt. Desgleichen wurden die Geographie, Handtafeln, Planetenhypothesen und das Planisphärium des PTOLEMÄUS übersetzt. Auch die Übersetzung der Elemente des EUKLID, die die Grundlage der mathematischen Kenntnisse der Araber bildete, und welche zu deren astronomischen Studien unentbehrlich wurde, erfuhren sehr früh schon eine Übersetzung durch AL-HAJJĀJ B. YŪSUF um 790. Ausserdem schenkten die Araber besonders den Werken des THEON VON ALEXANDRIA (Kanon, Gebrauch der Armillarsphäre, Anwendung des Astrolabs, Einleitung in den Almagest), ARISTARCHUS (Über die Grösse der Entfernung von Sonne und Mond), AUTOLYKUS (Die Auf- u. Niedergänge der Sterne etc.), sowie ARCHIMEDES, HERON, APOLLONIUS, DIOPHANT, etc. (vgl. M. STEINSCHNEIDER : *Zeitschr. d. Morgenländ. Gesellschaft*, 50, 163 ff. u. 337 ff.) Beachtung.

Durch Auszüge aus indischen Lehrbüchern wurden die Araber auf die beiden grossen astronomischen Lehrgebäude der Inder, nämlich das Brāhmasputasiddhānta (628 von BRAHMAGUPTA verfasst u. bei den Arabern unter dem Namen Sindhind bekannt), welches 154/771 wahrscheinlich im Auszug an den Hof von Bagdad gebracht wurde und das ĀRYABHAṬA (i.J. 500 verf.), worauf ABŪ' L-ḤASAN AL-AHWĀZĪ seine Tafeln der Planetenbewegungen gründete, aufmerksam.

Drittens ist noch der Einfluss der Sasanīden hervorzuheben.

Gegen das Ende ihrer Regierungszeit fanden die Pahlawī-Tafeln (zīj al-shah) durch eine arabische Übersetzung bei den Arabern Eingang.

Mit der politischen Machterhaltung der Chalīfen ging auch die Pflege der Wissenschaften parallel. Natürlich waren es, dem Zwecke entsprechend, nur einzelne Disciplinen, die sich einer besonderen Förderung erfreuten. Und zu diesen zählt die Astronomie, die, sofern sie sich mit den "Judizien aus den Gestirnen" befasste, in solcher Bedeutung als Astrologie besonders von den Fürsten geschätzt wurde. Und dieser Zweig der Wissenschaften — der mathematischen Wissenschaften ('ulûm ar-riyāḍīya)—wurde zum Alpha der übrigen in diesen Bereich gehörenden Disciplinen.

Ihre Blüteperiode erreichte die Astronomie unter dem Chalīfat von AL-MA'MŪN. In dessen Zeit wurden unter der Leitung von YAḤYĀ B. ABĪ MANṢŪR (gest. 830 oder 831) berühmte Beobachtungen auf der Sternwarte im Shammāsīya-Viertel in Bagdad angestellt, auf Grund derer die "Zīj al-Mumtahan" (Die erprobten Tafeln) entstanden. (3) Weiter folgen Beobachtungen auf dem Berge Qāsiyun (nördl. von Damaskus), sowie am "Bāb aṭ-Ṭāq" in Bagdad wo die BĀNŪ MŪSĀ b. Shākir Beobachtungen anstellten. AL-BATTĀNĪ wählte hierzu Shīrāz, Naisābūr, Samarkand und Ar-Raqqa. Als berechnender Astronom unter AL-MA'MŪN verdient besonders MUḤ. B. MŪSĀ AL-KHWĀRIZMĪ genannt zu werden, der durch sein Lehrbuch "Al-Jabr wa'l-Muqābala" sowie seine "zīj" einen unvergänglichen Ruhm geniesst (vgl. Die Herausgabe der astronomischen Tafeln des MUḤ. IBN MŪSĀ AL-KHWĀRIZMĪ, etc. *D. Kgl. Danske Vidensk. Selsk. Skrifter.* 7. Raekke. Historisk og Filosofisk Afd. III, 1. 1914 von H. SUTER). Auch hervorragende Übersetzer, wie THĀBIT B. QURRA, welcher die Theorie der Planetenbewegungen revidierte, AL-MĀHĀNĪ und AN-NAIRĪZĪ gehören der Wende des 9ten Jahrhunderts an. Und im Jahre 912/13 verfasste ḤABASH eine ausgezeichnet berechnete Tangenten- u. Kotangententafel, wozu er wohl durch die Arbeiten AL-BATTĀNĪ's geführt wurde. Dieser war ja ein Zeitgenosse von ihm und wurde vor allem dadurch berühmt, dass er die indischen Halbsehnen des doppelten Winkels—

(3) Zu Anfang des IXten Jahrhunderts wurden auch in Jundaisabūr Beobachtungen angestellt, welche den "zīj al-mushtamil" (Die allgemeinen Tafeln) von AḤMAD AN-NAHĀWANDĪ zugrunde liegen.

den Sinus—einführte. Er schuf eine von 1/2° zu 1/2° fortschreitende Sinustafel und führte auch die Tangente (Ẓill awwal, umbra versa) und Kotangente (Ẓill thānī, umbra recta) ein.

In der 2ten Hälfte des Xten Jahrhunderts treten die Būyidensultane in den Vordergrund. Diese gründeten in ihrem Palast eine Sternwarte und zogen vor allem folgende Gelehrte an ihren Hof: 'ABD AR-RAḤMĀN AS-SŪFĪ (*I. al-Qiftī*, 226; *Fihrist*, 284; ABŪ'L-FARAJ 325; SUTER: *Araber*, 62), welcher berühmt war in der Kenntnis der Örter und der Bewegung der Fixsterne; IBN AL-'ALAM (SUTER: *Araber*, 62), bekannt durch seine astronomischen Tafeln, WAIJĀN B. RUSTAM AL-KŪHĪ (siehe meine Diss.; auch bei den übrigen Gelehrten, bei welchen ich hier keine lit. Hinweise gebe); AHMAD AṢ-ṢAGHĀNĪ (*Ibn al-Qiftī*, 79; SUTER: *Araber*, 65) u. ABŪ' L-WAFĀ', welcher durch sein Buch "Über geometrische Konstruktionen" (vgl. H. SUTER: *A.G.N.M.*, H. 4, 94-109, Erlangen), worin eine Reihe von Aufgaben behandelt wird, deren Konstruktion eine konstante Zirkelöffnung zugrunde liegt, besonders bekannt wurde. ABŪ'L-WAFĀ' soll nach der Mitteilung von W. M. KUTTA (in *Nova acta, Abhdl. d. K. Leop.-Carol. Deutsch. Akad. d. Naturforscher*, 71, 3, 1897) der erste gewesen sein, der sich diese Bedingung für geometrische Konstruktionen gestellt hat. Weiter ist von ABŪ'L-WAFĀ' ausser der schon oben erwähnten 3ten Mondvariation noch seine Methode zur Berechnung von Sinustafeln von 1/4° zu 1/4° besonders hervorzuheben, weil selbige den sinus 1/2° bis zur 9ten Dezimale genau lieferte, sowie seine Formel für sin $(\alpha + \beta)$ (vgl. die Geschichtswerke v. CANTOR u. v. BRAUMMÜHL).

In Ghaẓna machte AL-BĪRŪNĪ seine Beobachtungen (Zu diesem Gelehrten ist E. WIEDEMANN u. H. SUTER: *Über Al-Bīrūnī und seine Schriften*, Beitrag 60, zu vergleichen).

Weithin bekannt wurde auch die Sternwarte zu Kairo, welche von dem Fatimidenkhalifen AL-'AZĪZ (365-386 = 975-996) gegründet wurde. Hier entstanden die auf Veranlassung des ägyptischen Khalifen AL-ḤĀKIM von IBN YŪNŪS (SUTER: *Araber*, 77) angefertigten grossen Ḥākimitischen Tafeln (al-zīj al-kabīr al-ḥākimī), und hier wirkte auch IBN AL-HAITHĀM, der für die Entwicklung der islamischen Kenntnis von der Optik grundlegend war.

In Spanien zeichneten sich vor allen Dingen JĀBIR B. AFLAḤ,

sowie AL-ZARQALĪ (SUTER : *Araber*, 109) durch bedeutende selbständige Leistungen aus.

In der Zeitperiode von 1200-1275 erreichten die Algebra mit 'OMAR AL-KHAYYĀMĪ und die Trigonometrie und Astronomie mit NAṢĪR AD-DĪN AṬ-ṬŪSĪ ihren Höhepunkt und die Zeit des Aufstiegs und der Blüte hat ihr Maximum erreicht. Es folgt die des Niedergangs, in welcher Periode nur noch die Astronomen des ULŪGH BEGS eine Würdigung verdienen.

Ich will hier nun noch eine Zusammenstellung der arabischen Autoren geben, die sich mit EUKLID befassten. Und zwar wähle ich an dieser Stelle die zeitliche Ordnung, im Gegensatz zu meiner Arbeit, wo ich die alphabetische vorzog.

Zur Zeitrechnung möchte ich kurz noch folgende Bemerkung hinzufügen, die ein Beispiel geben soll.

217 d. H. (Mondjahre) soll in christliche Zeitrechnung umgerechnet werden :

Es entsprechen 33 Mondjahre rund 32 Sonnenjahren.

Es entsprechen 217 Mondjahre rund 210 Sonnenjahren.

210 + 622 = 832.

Also rund 217 d. H. = 832 n. Chr.

1. JABIR B. ḤAYYĀN AṢ-ṢŪFI, aus Kūfa, 160 gest.
2. AL-ḤAJJĀJ B. YŪSUF B. MAṬAR, lebte ca. 170-220.
3. AL-'ABBĀS B. SA'ĪD AL-JAUHARĪ.
4. SIND B. 'ALĪ.
5. IBN RĀHIWAIH AL-ARJĀNĪ.
6. ḤUNAIN B. ISḤĀQ, geb. 194 in Ḥīra, gest. 260 oder 264 in Bagdad.
7. JA'QŪB B. ISḤĀQ AL-KINDĪ, geb. in Basra, gest. ca. 260.
8. MUḤ. B. 'ISĀ, AL-MĀHĀNĪ, aus Bagdad, gest. zwischen 260 u. 270.
9. THĀBIT B. QURRA, geb. 211 (nach einigen Quellen 221) in Ḥarran, gest. 288).
10. ISḤĀQ B. ḤUNAIN, gest. 298 in Bagdad.
11. QUSṬĀ B. LŪQĀ, gest. ca. 300 in Armenien.
12. AL-FAḌL B. ḤĀTIM AN-NAIRĪZĪ, gest. ca. 310.
13. MUḤ. B. ZAKARĪYĀ AR-RĀZĪ, geb. in Ray, gest. 320. (n.a. 311).
14. ABŪ 'UTHMĀN AD-DIMISHQĪ.
15. SINĀN B. THĀBIT B. QURRA, gest. 331 in Bagdad.
16. AL-FĀRĀBĪ, geb. ca. 260 in Fārāb, gest. 339 in Damaskus.
17. SULAIMĀN B. 'UQBA, ABŪ DĀ'ŪD.
18. AḤMAD B. AL-ḤUSAIN, AL-AHWĀZĪ, AL-KĀTIB.
19. ABŪ JA'FAR AL-KHĀZIN, geb. in Khurāsān, gest. zwischen 250 u. 360.

20. Yūḥannā b. Yūsuf al-Qass, gest. ca 370
21. Abū'l-Qāsim al-Anṭākī, gest. 376 in Bagdad.
22. Aḥmad b. 'Umar al-Karābīsī.
23. Ya'qūb b. Muḥ., Abū Yūsuf ar-Rāzī.
24. Nazīf b. Yumn al-Qass, gest. ca. 380.
25. Abū Isḥāq al-Ḥarrānī (?), gest. 384 in Bagdad (nach *Fihr.* vor 380).
26. Abū'l-Wafā', geb. 328 in Būzjān, gest. 387 oder 388.
27. Waijan b. Rustam al-Kūhī, geb. in Kūh.
28. Abū Sa'īd as-Sijzī, lebte um 340-415.
29. Manṣūr b. 'Alī b. 'Irāq, Zeitgenosse des vorhergehenden.
30. Ibn as-Samḥ, gest. 426 in Granada (?).
31. Ibn Sīnā, geb. 370 (I. A. Us. 375) in Efshene, gest. 428 in Hamadān.
32. Ibn al-Haitham, aus Baṣra, geb. ca. 354, gest. 430 (?) in Kairo.
33. Abū 'Abdallāh al-Juhanī, geb. 379, gest.?
34. 'Umar al-Khayyāmī, geb. ca. 430-440, gest. 517 in Nīshapūr.
35. Muẓaffar al-Isfarladī.
36. Muwaffaq ad-Dīn al-Arbilī, geb. in Baḥrain, gest. 585 in Arbala.
37. Faḥr ad-Dīn ar-Rāzī, Ibn al-Khaṭīb, geb. 544 (543) in Ray, gest. 606.
38. Kamāl ad-Dīn b. Yūnis, geb. in Muṣul i. J. 551, gest. 639 darselbst.
39. 'Alām ad-Dīn, geb. 574 (564?) in Aṣfūn, gest. 649 zu Damaskus.
40. Abū Zakarīyā Najm ad-Dīn, geb. 607 in Ḥaleb, gest. 666.
41. Naṣīr ad-Dīn aṭ-Ṭūsī, geb. 597 in Ṭūs, gest. 672 in Bagdad.
42. Muḥyī ad-Dīn al-Maghrabī, gest. zwischen 680 u. 690.
43. Shams ad-Dīn as-Samarqandī, Lebenszeit um 675.
44. Ibn al-Bannā, geb. um 656, gest. ca. 740 in Marokko.
45. Qāḍizādah ar-Rūmī, geb. zu Brussa, gest. ca. 840-850.

Literaturverzeichnis.

1. A. v. Braummühl, Vorlesgn. über Gesch. d. Trigonometrie, I, 1900.
2. *Encyclopädie des Islām* (soweit erschienen).
3. J. Frank u. M. Meyerhof: Ein Astrolab aus dem Indischen Mogulreiche, (Heidelberg, Verl. C. Winter, 1925).
4. Cantor: Vorlesgn. über Gesch. d. Mathematik, 3te Auflage, 1907.
5. Zu den Schriften von J. L. Heiberg bezüglich der Mathematik u. Naturw. bei den Griechen, vgl. H. Raeder: Johan Ludvig Heiberg (1854-1928), *Isis*, 11, 367-74, 1928.
6. C. Schoy; Zur Bibliographie von C. Schoy, vgl. J. Ruska: Carl Schoy (1877-1925), *Isis*, 9, 90-95, 1927.
7. T. L. Heath: A history of Greek mathematics, 2 vols., Oxford, 1921.
8. M. Steinschneider: Die Arabischen Übersetzungen aus dem

Griechischen, *Z. D. M. G. (Zeitschr. d. Deutsch. Morgenländ. Gesellsch.)*, 50, 163 ff. (Vgl. auch die hier zitierte Literatur).

9. PAULY-WISSOWA : Realencycl. d. klass. Altertumsw., 7, 1026 (1907).
10. H. SUTER (1848-1922), zu seiner Bibliographie vgl. *Abhandlungen z. Geschichte d. Naturw. und der Medizin (A.G.N.M.)*, H. 4, 1922. Besonders zu erwähnen sind dessen beide Abhandlungen :

a. Die Mathematiker und Astronomen der Araber und ihre Werke. *Abhdl. z. Gesch. d. Math. Wissensch.*, H. 10, 1900 (zitiert als SUTER : *Araber*).

Nachträge und Berichtigungen zu „Die Mathematiker und Astronomen, etc." *Abhdl. z. Gesch. d. math. Wissensch.* H. 14, 1902.

b. Die Übersetzung das Mathematikerverzeichnisses im Fihrist des IBN ABĪ YA'QŪB AN-NADĪM hat SUTER mitgeteilt in *Abhdl. z. Gesch. d. math. Wissensch.*, 6, 1892 (Zit. als SUTER: *Übers.*)

11. R. WOLF : Handbuch der Astronomie, ihre Geschichte und Literatur, 2 Bde., Zürich, 1890.
12. J. RUSKA : Zur ältesten arabischen Algebra und Rechenkunst, *Sitzungsber. d. Heidelb. Akademie d. Wissensch.*, 2. Abtlg., 1927.
13. E. WIEDEMANN : Beiträge zur Gesch. d. Naturwissenschaften, I-LXIV (sämtlich erschienen in den *Sitzungsberichten der physik.-med. Sozietät zu Erlangen*, 1902-1923).

Handschriftenverzeichnis (4).

(Die Zahlen in den Klammern bedeuten die entsprechenden Paragraphen in H. SUTER's *Araber*).

Elemente.

Algier : 1446, 1° (204); 1446, 3° (213).
Berlin : 5044 (198); 5918 u. 5919 (369); 5921 (204); 5922 (175); 5924 (124); 5925 (186); 5927 (88); 5942 (368); 5943 u. 5944 (430); 6009 (47).
Brit. Mus. : 388, 1332 u. 1333 (430); 974, 1334 u. 1335 (368); 978, 5° u. 979 (198).
Brit. Mus. P. Add. : 23570 (382); Brit. Mus. Suppl. : 751 (368).
Escurial : 947 (430).
Florenz : 272, 277 (368); 280 (430); 298 u. 313 (368).
Gotha : 1496 u. 1497 (382); 1498 u. 1499 (430).
Ind. Off. : 477, 1° (198) 734, 14° (185); 736-40 (368).
Kairo : 196 (430); 200 (368); 201 (66); 203 (175).

(4) Die Handschriftenkataloge sind bei SUTER : *Araber*, VIII angeführt.

Konstantinopel : 2640, 2661 (430); 2719 (376); 2720 (198); 2722 u. 2741 (368); 2743 u. 2744 (430).
Leiden : 965 (16 u. 88); 966 (204); 967 (266); 968 u. 969 (124); 974 (117); 1444 u. 1445 (198).
München : 848 (368); 849 (430).
Oxford, I : 456, 2° (198); 908, 1° (204); 919 (74); 949 (368); 958 (74); 967, 2° (382); 1012, 1° (368).
Oxford, II : 281 (140).
Paris : 2457, 5° u. 6° (98); 10° (185); 27° (185); 32° (66); 39° (47); 48° 131); 2465 u. 2466 (368); 2467, 5° (368); 2467, 6° (358 u. 368); 7° (88); 16° (47); 17° (124).
St. Petersburg : 133, 3° u. 241, 2° (430).

Data.
Berlin : 5929 (74 u. 368); 5939 (66).
Florenz : 271 (66, 74 u. 368); 273 u. 276 (368); 286 (66 u. 74).
Ind. Off. : 743, 1° (74 u. 368).
Kairo : 200 (74 u. 368); 202 (66).
Oxford, I. 875 u. 895 (74 u. 368); 960 (74).
Paris : 2458, 5° (204); 2467, 4° (66).

Optik.
Berlin : 6016 u. 6017 (368).
Florenz : 271 u. 286 (74 u. 386).
Ind. Off. : 743, 2° (368).
Kairo : 199 (368).
Leiden : 976 (74); 977 (74 u. 368).
Oxford, I. : 875 (74 u. 368); 895 (368).
Paris : 2467, 2° (45).

Phänomena.
Ind. Off. : 743, 3° (368).
Kairo : 205 (368).
Leiden : 1040 (74).
Oxford, I. : 875 u. 895 (74 u. 368).

Name und Leben.

In dem Namen *Εὐκλείδης* ist gr. *ἡ κλείς, ειδός* "der Schlüssel" zu erkennen, als solcher EUKLID bezeichnet wurde. Auch die verschiedenen arabischen Versionen des griechischen Namens in den Formen اوقليدس und اقليدس (5) worin اقليد "Schlüssel'

(5) *Fihrist*, 2, 1224; KLAMROTH : JA'QŪBI's Auszüge aus griechischen Schriftstellern, *Z. D. M. G.*, 42, 3.

vorhanden ist, galten zur Bezeichnung des EUKLID als مفتاح الهندسة (miftāḥ al-hindasa) "Schlüssel der Geometrie".

EUKLID, der Mathematiker, dessen Wirkungsbereich sicher in Alexandria zu suchen ist, und dessen Geburtsort bis auf die heutige Zeit uns unbekannt geblieben ist, wurde um die Mitte des 14. Jahrhunderts häufig mit EUKLID, dem Megarer (*ὁ Μεγαρικός*), einem Schüler des SOKRATES (daher auch *ὁ Σωκρατικὸς ἀνήρ* genannt) und Gründer der megarischen Philosophenschule, verwechselt. Dieser lebte in der Zeit zwischen 450 und 380.

Die Epoche unseres Autors können wir nicht bestimmt angeben. Doch aber sollen uns folgende Erwägungen einen ungefähren Hinweis geben. Um über die Zeit und Wirksamkeit EUKLIDS einen Aufschluss zu erhalten, müssen wir uns auf das stützen, was uns PROKLUS in Procli Diadochi in primum Euclidis elementorum librum commentarii (6) von ihm berichtet. PROKLUS benutzt hierbei als Hauptquelle das mathematische Werk des GEMINOS (7) (*Γεμῖνος* bei PROKLUS u. PAPPUS; *Γεμίνος* bei SIMPLICIUS) (8) *ἡ τῶν μαθημάτων θεωρία*, welches bei PAPPUS unter *Γεμῖνος ὁ μαθηματικὸς ἐν τῷ περὶ τῆς τῶν μαθημάτων τάξεως* (*τάξις* = geordnete Gliederung) (9) angeführt wird.

Einige grössere Abschnitte hieraus sind uns wohl fast in wortgetreuer Übersetzung nach dem uns verloren gegangenen griechischen Urtexte im Arabischen erhalten in dem Kommentar des ANARITIUS (10).

a) Wir entnehmen aus GEMINOS (11), dass EUKLID die Schriften der Schüler PLATONS (429-348), EUDOXOS (12) und THEAITETOS (13)

(6) Ex recogn. GOD. FRIEDLEIN, Lips. 1873.

(7) Zu GEMINOS = AGANIS vgl. M. CURTZE : Anaritii in decem libros priores elementorum Euclidis comentarii (Ex interpretatione Gherardi Cremonensis in Codice Cracoviensi 569 servata) Lips., 1899, Praef. VIII, 13; P. TANNERY : Le philosophe AGANIS est-il identique à GEMINOS, *B. M.* 2, (1901) ; HULTSCH, *Berl. Phil. Wochenschrift*, 1284 (1899); PAULY-WISSOWA, *R. E.* VII, 1026 (1907).

(8) CANTOR, I_3, 410.

(9) PAPPUS, VIII, 3 (ed. HULTSCH), 1026.

(10) Hrsg. von R. O. BESTHORN und I. L. HEIBERG (Cod. Leid. 399, 1) 1893-1905, Kopenhagen.

(11) PROCLI DIADOCHI... (ed. FRIEDLEIN) I, 68.

(12) EUDOXOS VON KNIDOS, Sohn des AISCHINES (390-337), mit dem 23. Lebensjahr Schüler von PLATO. Er war berühmt als Mathematiker. Nach PROCLUS stammt von ihm das V. Buch der Elemente des EUKLID, sowieXII I, Satz 1-5.

(13) *Θεαίτητος*, Sohn des EUPHORIUS, aus Sunium, war Sokratiker. PLATO erwähnt ihn in seinen Dialogen.

benutzt hatte; ebenso, dass er von ARCHIMEDES erwähnt wurde. Hieraus zog HEIBERG (14) den Schluss, dass die Lebenszeit des EUKLID zwischen die Schüler PLATOS einerseits und der Lebenszeit des ARCHIMEDES andererseits, seine Blütezeit also um das Jahr 300 anzusetzen ist.

b) Es kann ohne Zweifel festgestellt werden, dass AUTOLYKOS von Pitane (in Aiolis), dessen Blütezeit um das Jahr 310 liegt, ein Zeitgenosse von EUKLID war. Jedoch führt uns seine schriftstellerische Tätigkeit in eine frühere Zeit, was daraus gefolgert werden kann, dass EUKLID in seinen Phainomena auf den Schriften des AUTOLYKOS (15) fusst. Es sind dies : *περὶ κινουμένης σφαίρας* (über die rotierende Kugel) und *περὶ ἐπιτολῶν καὶ δύσεων* ("über die Auf- u. Untergänge" der Fixsterne). AUTOLYKOS lebte umgefähr um das Jahr 330 (16). Auf Grund dessen folgerte man für EUKLIDS Lebenszeit das Jahr 295 als Höhepunkt in seinem Schaffen.

c) Zu dem Ergebnis von H. VOGT (17) ist zu bemerken, dass es weniger auf Genauigkeit rechnen kann, wie sie für die oben angeführten zwei Erwägungen zutrifft.

Nunmehr lasse ich eine vollständige Übersetzung des Artikels über EUKLID aus *I. al-Q.*, 62 folgen (18).

„EUKLID" (19), der Geometer (20) und Zimmermann, aus Tyrus (21), ist der Sohn des NAUKRATES, des Sohnes des BERENEIKES. Er hat die Geometrie (Handasa oder 'Ilm al-Han-

(14) HEIBERG : Lit. Studien über EUKLID, 25-26, Leipzig, 1882.

(15) *Fihrist*, 268 (21) I. Al-Q., 73 : AUTOLYKOS (اوطولوقس), ein berühmter griechischer Geometer, wurde erwähnt in seiner Zeit. Er ist der Verfasser von berühmten Abhandlungen, welche unter den Gelehrten von Hand zu Hand gingen. Zu seinen Werken gehören : Über die sich bewegende Sphäre, verbessert von AL-KINDĪ.

Über den Auf.—u. Untergang, in drei Maqālen. Vgl. auch STEINSCHNEIDER, *Math.* § 125; E. W., B. V, 395; CANTOR, I_3, 293, 447.

(16) HULTSCH in der Vorrede zu seiner AUTOLYKUS-Ausgabe, Leipzig, 1885.

(17) *B. M.* III. Folge, 13, 193 (1912-13). H. VOGT kommt hier zu dem Resultat, dass die Geburt des EUKLID auf das Jahr 365, dessen Blütezeit um 325, und die Abfassung der Elemente in die Zeit von 330-320 fällt.

(18) Vgl. *E. W.*, B. V, 445.

(19) Vgl. auch *Fihrist*, 265 (16-17); KLAMROTH : JA'QŪBĪ's Auszüge etc., *Z.D.M.G.* 42, 3; E. W., B. V., 451 (Angaben bei QAZWĪNĪ); CANTOR, I_3, 260 ff.; STEINSCHNEIDER : *Math.*, § 86.

(20) Al-muhandis.

(21) CANTOR, I_3, 260 u. 360.

dasa) (22) geschaffen und sich in ihr ausgezeichnet. Er ist als Begründer der Geometrie (صاحب جومطريا) bekannt. Der Name seines Buches über die Geometrie ist im Griechischen al-Usṭurūshīyā (الأسطروشيا) (23). Die Bedeutung dieses Wortes ist "Prinzipien der Geometrie" ('Uṣūl al-Hindasa). Er war ein Weiser der alten Zeit, ein Grieche von Nationalität, ein Syrer dem Heimatlande nach und ein Tyrer nach der Vaterstadt, dem Gewerbe nach ein Zimmermann (najjār). Er besass ein sehr grosses Können in der geometrischen Wissenschaft. Seine unter dem Namen al-Arkān (الاركان) (24) bekannte Schrift hat bei den griechischen Gelehrten diesen Namen. Nach seinem Tode nannten es die Rumäer al-Usṭuquṣṣāt (الأسطقصات) und die Mohammedaner al-Uṣūl. Es ist ein Werk herrlich an Wert, gross an Nutzen. Es ist die Grundlage für dieses Gebiet. Vor ihm hatten die Griechen kein zusammenfassendes Werk über diesen Gegenstand. Nach ihm (EUKLID) kam keiner, der sich nicht um dasselbe herumdrehte und sich seiner Worte bediente. An ihm plagte sich eine Menge griechischer, rumäischer und muhammedanischer Mathematiker (riyāḍiyy) ab, in gleicher Weise der, der es erklärt (shariḥ), der, der auf Grund von ihm Lehrsätze (25) aufstellt, und der, der den von ihm gespendeten Nutzen herausbringt, und in dem Volk war keiner, der sich nicht vor seiner Vollkommenheit beugte und nicht Zeugnis ablegte für die Trefflichkeit seiner Gabe.

Die griechischen Gelehrten pflegten über die Tore ihrer Schulen zu schreiben "In unsere Schule soll keiner eintreten, der nicht Mathematiker ist" (26). Sie meinten damit, dass in sie keiner

(22) Handasa kommt vom pers. Verbum اندخمسه oder اندازيدن "werfen, messen, machen". Subst. اندازه "Elle, Mass, Yard, Grösse, Ausdehnung, Proportion, Symmetrie". Vgl. E. W., B. XIV, 2; H. SUTER : *Encycl. d. Islām*, 2, 272.

(23) Siehe später.

(24) Es ist der Plural von Rukn, welches dem Sinn nach mit Usṭuquṣṣ äquivalent ist. Al-Usṭuquṣṣ ist der Grundbestandteil des Zusammengesetzten, und wird hier als al-Arkān für *Στοιχεῖα* gebraucht. Vgl. *Fihrist*, 2, 122; E. W., XIV, 3 (ebenso ist al-Usṭuquṣṣāt eine häufige arab. Übersetzung des gr. *Στοιχεῖα*). Vgl. auch KLAMROTH : Über den arabischen Euklid, *Z. D. M. G.*, 284.

(25) Shakl pl. ashkāl, eigentlich "Figur" vgl. KLAMROTH : *Euklid*, 285.

(26) لا يدخلنّ مدرستنا من لم يكن مرتاضا Stimmt dem Sinn nach mit PLATOS (Zu PLATON in arabischer Überlieferung vgl. CARRA DE VAUX : Aflāṭun, *Encycl. d. Islām*, 1, 186) "*μηδεὶς ἀγεωμέτρητος εἰσίτω μοῦ τὴν στέγην*" überein. CANTOR I_3, 216.

eintreten solle, der nicht das Werk des EUKLID studiert hätte.

Und von EUKLID rührt über dieses Gebiet her : Das Werk "Data" (mafrūḍāt). Das Werk über die Optik (al-manāẓir). Das Werk über die Zusammensetzung der Melodien (ta'līf al-laḥūn) und andere.

YA 'QŪB B. 'ISḤĀQ AL-KINDĪ (27) sagt in einer seiner Abhandlungen : Er (EUKLID) war von grosser Einsicht. Einer der griechischen Könige fand in den Bibliotheken zwei Werke, die APOLLONIUS (28), dem Zimmermann, zugeschrieben wurden. In ihnen war die Herstellung der fünf Körper (29) beschrieben, die die einzigen sind, welche eine Kugel (kura) umschreibt (30). Er suchte nach einem, der ihm die Schwierigkeiten der beiden Bücher löste; doch, er fand keinen auf griechischem Boden, der dies gekonnt hätte. Da befragte er diejenigen, welche aus den verschiedenen Gegenden zu ihm kamen, und einer der Befragten teilte ihm mit, dass er in Tyrus einen Mann namens EUKLID gesehen habe, dessen Gewerbe die Zimmermannskunst war und der über diese Gegenstände gesprochen und sich mit ihnen beschäftigt habe.

Da schrieb der König sogleich an den König des Gestades (Phönizien) und schickte ihm eine Abschrift der beiden oben erwähnten Bücher mit der Bitte, den EUKLID wegen ihrer Erklärung zu befragen. Das tat der König von Phönizien (malik as-sāḥil) (31) und wandte sich an EUKLID in dieser Angelegenheit. EUKLID war der kenntnisreichste seiner Zeit auf dem Gebiet der Geo-

(27) Ich komme auf jene Autoren, bei welchen ich i. f. keine Anmerkungen gebe, a. a. O. zu sprechen.

(28) *I. al-Qifṭī*, 61 (Übers. E. W., B. III, 245) ; *Fihrist*, 266 (18-19) ; STEINSCHNEIDER : *Math.*, § 102 ; KLAMROTH : JA'QŪBĪ's Auszüge, *Z. D. M. G.*, 41, 419. Weitere arab. Mittlgn. über ihn E. W., B. III, 234; IV, 395, 438; XIV, 11[2] XXXVI, 20. CANTOR, I$_3$, 327-349, 704-05, 749, 751; T. L. HEATH : Greek Mathematics, 2, 127, Oxford, 1921.

(29) Jism pl. ajsām. Es sind dies folgende : 1) ash-shakl an-nārī (Die feuerartige Figur), τετράεδρον ; 2) ash-shakl al-arḍī (Die erdartige Figur), κύβος ; 3) ash- shakl al-hawā'ī (Das luftartige Gebilde), ὀκτάεδρον ; 4) ash-shakl al-māī (Die wasserartige Figur), εἰκοσάεδρον; 5) ash-shakl al-falakī (der sphärenartige Körper) vgl. E. W., B. V, 447; XIV, 8. KLAMROTH, *Z. D. M. G.*, 35, 300.

(30) Nach CASIRI, I, 399 ist nicht von den fünf Körpern, sondern von den Kegelschnitten die Rede.

(31) sāḥil pl. sawāḥil "Küste, Gestade".

metrie (32) und legte ihm (dem König) den Inhalt der beiden Bücher dar und erklärte ihm das von APOLLONIUS in ihnen verfolgte Ziel. Dann entwickelte er die Grundlagen (al-'Ūsūl), um zur Kenntnis dieser fünf Körper zu gelangen. So entstanden die dreizehn Bücher, die EUKLID zugeschrieben werden. Zu einem Ganzen vereinigte sie ein Mann nach EUKLID, der ihnen auch die beiden Bücher hinzufügte, in denen über Dinge gehandelt wird, die nicht von APOLLONIUS herrühren, nämlich über das Verhältnis eines dieser fünf Körper zu dem andern und über die Einzeichnung eines derselben in den andern (33). Es gibt Leute, die diese beiden Bücher einem andern als EUKLID zuschrieben und meinen, dass sie nur dem Buch angehängt seien.

Und es wird in der Chronik der Gelehrten erwähnt, dass er früher lebte als ARCHIMEDES (34) ('Arshemīdis) und andere und dass er ein Mathematiker (min al-falāsife ar-riyāḍiyyīna) war und was sein Buch über die Elemente der Geometrie anbetrifft, so wurde es von AL-ḤAJJĀJ B. YŪSUF B. MAṬAR AL-KŪFĪ (35) übersetzt. Die erste Übersetzung ist bekannt als die Hārūnische (36), die zweite als die Ma'mūni'sche (37), auf welche man sich verliess. Auch übersetzte es 'IṢḤĀQ B. ḤUNAIN, und THĀBIT B. QURRA AL-ḤARRĀNĪ verbesserte es. Auch übersetzte 'ABŪ 'UTHMĀN AD-DIMISHQĪ einige Maqālen (zwei Maqālen?) desselben. Es erzählt 'IBN AN-NADĪM : Ich sah das zehnte in Mossul in der

(32) Vgl. *E. W.*, B. XIV, 3^6, wo *E. W.* eine Übersetzung von Versen des ABŪ 'ALI, dem Geometer (SUTER : *Araber*, 118; *I. al-Qiftī*, 410-11) gibt, worin EUKLID als Geometer verherrlicht wird.

(33) CANTOR, I_3, 358; T. L. HEATH : *Greek Mathematics*, 1, 419-20; 2, 192.

(34) *I. al-Qiftī*, 66 (Übers. E. W., B. III, 247); *Fihrist*, 266 (17). KLAMROTH : Auszüge, *Z. D. M. G.*, 42, 2; Angaben bei QAZWĪNĪ, E. W., B. V, 451. Weitere arab. Nachrichten zu ARCHIMEDES in E. W., B. VII, 152; X, 347; XIII, 248; XIV, 11^3, 62; XV, 105; XXXVI, 18. Vgl. auch CANTOR, I_3, 295 ff.; 703, 704, 705, 749; T. L. HEATH : *Greek Mathematics*, 2, 16 ff.; STEINSCHNEIDER : *Math.* § 95-100.

(35) SUTER : *Araber*, 9. Zeitgenosse von al-MA'MŪN und AR-RASHĪD. Nach I. A.-Uṣ. 1, 204 soll er die Euklidübersetzung des THĀBIT B. QURRA verbessert haben. SUTER vermutet eine Verwechslung mit ISḤĀQ B. ḤUNAIN. (SUTER : *Araber*, 39 sowie dessen Artikel in *Encycl. d. Islām*, 2, 569).

(36) HĀRŪN AR-RASHĪD war der berühmteste 'abbāsidische Khalīf. Er wurde zu ar-Ray geboren i. J. 145/763 (oder 148/766); gest. i. J. 193/809. Er zeigte ein grosses Interesse für Kunst und Wissenschaft u. sein Hof war ein Mittelpunkt der Gelehrten aller Art. Vgl. K. v. ZETTERSTÉEN : *Encycl. d. Islām*, 2, 287.

(37) Zu AL-MA'MŪN (170/785-218/833) vgl. WEIL : *Geschichte der Chalifen*, 2, 198-294.

Bibliothek des 'ALĪ B. 'AḤMAD AL-'IMRĀNĪ (38). Einer seiner Diener war 'ABŪ'Ṣ-ṢAQR AL-QABĪSĪ (39) und dieser las ihm den Almagest (al-majisṭī) (40) vor zu unserer Zeit, nämlich im Jahre 370. Und es kommentierte dann HERON (41) die Elemente

(38) Geb. in Mossul; Gest. 344 (955/56). Vgl. SUTER : *Araber*, 56 ; *Fihrist*, 283 (39); *I. al-Qiftī*, 233 :

'ALĪ B. AḤMAD AL-'IMRĀNĪ aus Mossul war gelehrt in der Rechenkunst (Ḥisāb) und der Geometrie. Und er war ein ausgezeichneter Sammler von Büchern, welche ihm die Leute zuwandten, um Vorteile daraus zu gewinnen. Und es kamen zu ihm aus den entferntesten Ländern Studenten, um seine Vorlesungen zu hören. Er starb im Jahre 344. Zu seinen Werken gehören : Kommentar zur Algebra (a) des 'ABŪ KĀMIL SHUJĀ' B. ASLAM [*Fihrist*, 281 (37); SUTER: *Araber*, 43; *I. al-Qiftī*, 211 : SHUJĀ' B. ASLAM B. MUḤ. B. SHUJĀ', der Rechner, der Ägypter, ABŪ KĀMIL, war ausgezeichnet in seiner Zeit, ein Gelehrter seiner Zeit und ein Rechner seiner Zeit. Er hatte Schüler, welche durch sein Wissen ausgebildet wurden. Er verfasste auf diesem Gebiet erhabene Werke). Buch über die Tagewählerei (ichtiyārāt). Eine Anzahl von Werken über die Astrologie und was damit zusammenhängt".]

(39) *Encycl. d. Islām*, 2, 635. Sein vollständiger Name ist 'ABD AL-'AZĪZ (oder auch 'ABD AR-RAḤMĀN) B. UTHMĀN B. 'ALĪ ABŪ'Ṣ-ṢAQR. (SUTER : *Araber*, 60).

(40) Auch al-mijistī oder kitāb al-majisṭī. Es ist das Werk des PTOLEMÄUS μεγάλη σύνταξις, (Die grosse Zusammenstellung). Die erste arab. Übersetzung des Almagests fällt wahrscheinlich in die Wende des VIII. Jahrhunderts, welcher 212 (827/828) die des AL-ḤAJJĀJ B. YŪSUF B. MATAR folgte, sowie die des ḤUNAIN B. 'ISḤĀQ in der zweiten Hälfte des IX. Jahrhunderts, welche von THĀBIT B. QURRA revidiert wurde. Vgl. H. SUTER : *Encycl. d. Islām*, I, 329; STEINSCHNEIDER : *Math.* § 113; CANTOR, I_3, 702.

(41) إهرانت (vgl. zum Namen CANTOR I_3, 705). *Fihrist*, 269 (22); *Ibn al-Qifti*, 73 (Übers. E. W., B. III, 251) vgl. auch E. W., B. III, 228, woselbst eine Mitteilung

(a) al-Jabr wa'l-muqābala "Wiederherstellung und Vergleichung". BAHĀ' AD-DĪN AL-'ĀMILI (*Encycl. des Islām*, 1, 343). definiert in seiner Chulāṣat al-Ḥisāb (Essenz der Rechenkunst, arab. u. deutsch von NESSELMANN, 41-42, Berlin, 1843, Übers. 41) diese Begriffe folgendermassen : Die Seite, die eine Negation (negatives Glied) enthält, wird wieder vollständig gemacht, und auf der andern Seite ein jenem gleiches Glied hinzugefügt, das ist al-Jabr; die gleichen oder gleichartigen Glieder auf beiden Seiten werden weggehoben, das ist al muqābala.

Beispiel : $17x - 8 = 8x + 19$ linke Seite unvollständig, da sie ein negatives Glied enthält.

Vervollständigt hat sie die Form $17x = 8x + 27$.

Durch Vergleichung der beiden Seiten stellen wir den Überschuss von $8x$ fest, mit welchem wir ausgleichen.

So erhalten wir $9x = 27$, welches auf $x = 3$ zurückgeführt wird. Vgl. *Encycl. d. Islām*, 1, 1031 sowie J. RUSKA : Zur ältesten arabischen Algebra und Rechenkunst (*Sitzungsber. der Heidelberger Akademie der Wissenschaften*, 2. Abhdlg., 1917). In CANTOR, I_3, 719 vgl. J. RUSKA, *l. c.*, 10 Anm.

(shukūk, Schwierigkeiten, Zweifel) (42) dieses Buches. Und ferner kommentierte es AN-NAIRĪZĪ und ein Mann namens AL-KARĀBĪSĪ (43), dessen noch Erwähnung getan wird in der zweiten (Hälfte) dieses Werkes, so Gott, erhaben ist er, es will. Ein Kommentar zu diesem Buche rührt von AL-JAWHARĪ her, welcher dieses Buch von Anfang bis zu Ende kommentierte. AL-JAWHARĪ wird auch noch erwähnt werden. Auch existiert ein Kommentar zum fünften Buche von AL-MĀHĀNĪ. Und es berichtete ferner NAZĪF, der Arzt (al-muṭabbib), dass er das zehnte Buch des EUKLID griechisch gesehen habe. Und dasselbe hatte vierzig Sätze mehr als das, welches in den Händen der Leute war, und dieses hatte 109 Sätze, und dass er sich entschlossen habe, dasselbe ins Arabische zu übersetzen. Es erzählte auch YŪḤANNĀ AL-QASS (44), dass er den Satz (ash-Shakl "die Figur!") gesehen habe, welchen THĀBIT B. QURRA im ersten Buche für sich in Anspruch nahm und dass es (ihm) sei in einem griechischen Exemplar. Und es erwähnt auch NAZĪF, dass er es ihm gezeigt habe. Auch hat ABŪ ḤAFṢ AL-ḤĀRITH AL-KHURĀSĀNĪ—er wird noch erwähnt werden—das Buch des EUKLIDES kommentiert, desgleichen ABŪ' L-WAFĀ' AL-BŪZJANĪ; er vollendete es aber nicht. ABŪ' L-QĀSIM AL-'ANṬĀKĪ kommentierte das ganze Buch, nachdem es übersetzt worden war, (45) und es wurde von den Studenten benutzt. Auch kommentierte es SANAD B. 'ALĪ—es sah ABŪ 'ALĪ neun Bücher desselben und einen Teil des zehnten (46). — Das zehnte kommentierte auch ABŪ YŪSUF AR-RĀZĪ,

über diesen Autor aus der „Beschreibung Ägyptens von AL-KINDĪ (a) und der darin erwähnten Gelehrten" gegeben ist.

STEINSCHNEIDER: *Math.* § 132; Weitere arab. Nachrichten über HERON E. W., B. B. IV, 407 ff.; VI; XII, 200 ff.

(42) Ḥall Shukūk: Lösung der Zweifel, STEINSCHNEIDER: *Math.* § 132, 1. CANTOR, I_2, 386 ff.

(43) *Fihr.:* 282 (38); SUTER: *Araber*, 65; *Encycl. d. Islām*, 2, 779.

(44) Vollst. Name: YŪḤANNĀ B. YŪSUF B. AL-ḤĀRITH B. AL-BAṬRĪQ, AL-QASS.

(45) Zu وقف حرج vgl. *Fihrist.* Übers., 49 Anm. 45.

(46) Vgl. *Fihrist*, 266, 8 (17, 12). Nach *I. al-Qiftī*, 64, 20 ist diese Stelle unklar. Man möchte darnach vermuten, dass SANAD B. 'ALĪ 9 Maqālen und einen Teil des zehnten Buches kommentierte. Der in *Ibn al-Qiftī* nicht angeführte Name ABŪ 'ALĪ führt auch zu einer gewissen Schwierigkeit. SUTER vermutet hier

(*a*) Zu ABŪ 'OMAR MUḤ. B. YŪSUF B. YA'QŪ AL-KINDĪ AT-TUJIBĪ vgl. *Encycl. d. Islām*, 2, 1096.

und er machte es vortrefflich im Auftrage von 'IBN AL-'AMĪD (47).

Und es erwähnte AL-KINDĪ in seiner Abhandlung (risāla) über die Zwecke (gharaḍ pl. aghrād "Ziel, Zweck") des EUKLIDischen Buches, dass dieses Buch von einem Mann, namens APOLLONIUS, dem Tischler (48), verfasst worden sei und dass er es in fünfzehn Abhandlungen (qaul) entwarf. Als die Zeit nun, zu der dieses Buch verfasst worden war, lange vorüber war und es vernachlässigt wurde, da entschloss sich einer der Könige von Alexandria zum Studium der Geometrie. Zu seiner Zeit lebte EUKLIDES und diesen beauftragte er mit der Umarbeitung ('Iṣlāḥ) dieses Buches und dessen Kommentierung. Da führte er dieses aus und arbeitete dreizehn Kapitel (maqāla) desselben um und so wird es auf ihn (als Verfasser) zurückgeführt. Später fand HYPSIKLES (49), ein Schüler des EUKLIDES, noch zwei Bücher, das 14. und 15. und er brachte sie dem König und dieselben wurden dem Buche noch hinzugefügt. Dies alles geschah in Alexandria. Auch wurden kommentiert von ABŪ 'ALĪ AL-ḤASAN B. AL-ḤASAN B. AL-HAITHAM AL-BAṢRĪ, einem Ägypter, die muṣādarāt (50) dieses Buches und von ihm wird auch erwähnt, dass er die Schwierigkeiten dieses Buches und deren Lösung (al-jawab 'an ash-Shukūk) gezeigt habe. Und ich sah den Kommentar der zehnten Maqāla eines alten griechischen Gelehrten, mit Namen BALĪS (51), welcher ins

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'IBN ABĪ QURRA, ABŪ 'ALĪ, der Astrolog des Fürsten von Baṣra. (SUTER : *Araber*, 33; *Fihrist*, 278 (34); *I. al-Qiftī*, 409_{17}).

(47) *Encycl. d. Islām*, 2, 382; SUTER : *Araber*, 58.

(48) Vgl. *Fihrist* : Übers., 49 Anm. 46.

(49) *I. al-Qiftī*, 72 : "HYPSIKLES ('IBSQILĀUS, 'INSQILĀUS, 'ISQILĀUS), ein Gelehrter in seiner Zeit, sehr erfahren in den mathematischen Wissenschaften, hervorragend darin unter den griechischen Gelehrten, wird als berühmt in dieser Kunst von den Gelehrten dieser Kunst erwähnt. Er lebte nach der Zeit des EUKLID und schrieb schöne Werke auf diesem Gebiet. Er gab darin nützliche Hinweise. Zu seinen Abhandlungen gehören : 1) Über die Körper und (deren) Entfernungen (Kitāb al-'Ajram wa'l-al-'Abād); 2) Ein Buch über die Aufgänge, d. h. über den Auf- und Untergang der Gestirne (Kitāb al-matāli' wah' wa aṭ-ṭulū' wa'l-ghurūb "ἀναφορικός"), eine Maqāle; 3) Er verbesserte ('aṣlaha)? das 14. und 15. Buch des EUKLIDES. Vgl. *Fihrist*, 266 (18). STEINSCHNEIDER : *Math.* § 101. CANTOR, I_3, 358 ff.; T. L. HEATH : *Greek Mathematics*, 2, 213 ff.

(50) al-muṣādarāt bedeutet bald allgemein "die Prämissen" (Axiome, κοιναὶ ἔννοιαι ; Definitionen, ὅροι ; Postulate, αἰτήματα), bald speziell "Postulate". Vgl. E. W., B. XIV, 4; KLAMROTH : Über den arab. Euklid, *Z. D. M. G.*, 35, 286; T. L. HEATH : *Greek Mathematics*, I, 373.

(51) Dieser Name kommt auch noch vor in den Formen BALĪNŪS, BALĪNĀS, TALBIS, ABULĪNUS. Die richtige Form ist ABULUNĪŪS. Man versteht in der

Arabische übersetzt wurde. Und ich besitze es in einer Handschrift des 'IBN KĀTIB ḤALĪM (52) (AL-ḤALĪM "Der Milde"; auch AL-ḤAKĪM "der Weise" kommt vor). Lob sei Allah! — Und ich sah den Kommentar des zehnten Buches von AL-QĀDĪ ABŪ MUḤ. B. 'ABD-AL-BĀQĪ AL-BUGHDĀDĪ AL-FARAḌĪ, bekannt als QĀDĪ AL-BĪMĀRISTĀNĪ, und es ist ein sehr schöner Kommentar. Darin sind die Figuren mit Zahlen verglichen und ich habe dieses Exemplar in einer Handschrift seines Verfassers — Lob sei Allah, dem Einzigen! — Und es erwähnt ABŪ AL-ḤASAN AL-QUSHAIRĪ AL-ANDALUSĪ — Gott habe ihn selig! — dass ein anderer Andalusier zu diesem Buche einen Kommentar schrieb, dessen Namen er erwähnte, welchen ich aber vergass. Diese seine Worte wurden mir zuteil in Jerusalem (b.ital-muqaddas) im Jahre 595.

1) Das Buch der himmlischen Erscheinungen (kitāb al-Zāhirāt).

2) Das Buch von der Verschiedenheit der Bilder (kitāb ichtilāf al-manāẓir).

3) Das Buch der gegebenen Grössen (kitāb al-mu' ṭayāt).

4) Das Buch der Töne, bekannt unter dem Namen "die Musik" (al-mūsīqī).

5) Das Buch der Teilung (al-Qisma), verbessert von THĀBIT.

6) Das Buch der Nutzanwendungen (al-fawā'id).

7) Das Buch des Kanon (al-Qānūn).

8) Das Buch vom Schweren und Leichten (al-thiql wa' l-ḥaffa).

9) Das Buch der Synthese (al-tarkīb).

10) Das Buch der Auflösung (al-taḥlīl).

Die Elemente (*Τὰ Στοιχεῖα*) (53)

EUKLID wurde von der Zeit des ARCHIMEDES an darnach als

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arab. Lit. bald APOLLONIUS VON TYANA, bald APOLLONIUS VON PERGAMON darunter. Hier ist ohne Zweifel letzterer gemeint. Vgl. auch *Encycl. d. Islām*, I, 645.

(52) Vielleicht ist dies MUḤ. B. 'ABDARRAḤMĀN ABŪ 'ABDALLAH, welcher bekannt ist unter dem Namen 'IBN AL-KĀTIB. Vgl. SUTER: *Araber*, 133.

(53) Auch zitiert als: *Εὐκλείδου στοιχείων α, β.* — *τὰ Εὐκλείδου* — *ἡ Εὐκλείδου* — *ἡ Εὐκλείδου στοιχείωσις* — *ἡ στοιχείωσις* — *τὰ πρῶτα στοιχεῖα*. Vgl. PAULY-WISSOWA, *R. E.*, VI, 1907. Lit. HEIBERG und MENGE: *Kritische Gesamtausgabe auf breiter handschriftl. Grundlage*, Leipzig, 1883-1916; I-VIII. Nachträge, *Hermes*, XXXVIII, 46 ff.; 321 ff. Vor allem aber T. L. HEATH: *The thirteen books of Euclid's Elements*. (I-III, Cambridge, 1908); CANTOR, I_3, 258-78. KLAMROTH: *Über den arab. Euklid*, *Z. D. M. G.*, 35, 270-326.

"JA'QŪBIS Auszüge aus griech. Schriftstellern, *Z. D. M. G.*, 42, 3; *Fihrist*, II, 122, 6; HEIBERG, *Die arab. Tradition der Elemente des Euklid*, *Z. f. M.*, Histor.-liter.-Abteilung, 29, 1-22; E. W., B. V, 395; XI, 86; XVII, 8; XIV, 3.

ὁ στοιχειώτης unter Weglassung des eigentlichen Namens zitiert. Er fasste in den Στοιχεῖα die Errungenschaften der mathematischen Forschung auf dem Gebiet der Elementargeometrie in ein festgefügtes System zusammen. Dass er bei PROKLUS schlechthin ὁ γεωμέτρης genannt wird, hat seinen Grund darin, dass er die Elemente der Geometrie behandelt hat.

Die "Elemente" zerfallen in 13 Bücher, deren ersten sechs sich mit planimetrischen Fragen befassen. Die Bücher VII-IX behandeln vorwiegend arithmetische Probleme. Das Buch X befasst sich ausschliesslich mit der Inkommensurabilität. In den Büchern XI (Sätze, welche auf parallele u. senkrechte gerade Linien u. Ebenen sich beziehen; Parallelepipedon, Prisma), XII (Lehre von dem Masse des körperlichen Inhaltes der Pyramide, des Prisma, des Kegels, Zylinders u. der Kugel) und XIII (über regelmässige einem Kreise eingeschriebene Viele ke vgl. auch Buch IV) wurden stereometrische Fragen einer eingehenden Behandlung unterzogen (54). Diesen 13 Büchern des EUKLID werden in den Handschriften desselben mehrfach noch zwei weitere Bücher, das sogen. XIV. und XV., stereometrischen Inhalts, angehängt (55). Das XIVte Buch, welches in den Handschriften als eine Fortsetzung des EUKLID (τὸ εἰς Εὐκλείδην ἀναφερόμενον) bezeichnet wird, ist eine Abhandlung über regelmässige Körper von (56) HYPSIKLES (57). Aus dem Vorwort des Buches geht hervor, dass es ursprünglich nur eine Erläuterung zu APOLLONIUS verloren gegangener Schrift über das Dodekaeder und Ikosaeder sei. (περὶ τῆς συγκρίσεως τοῦ δωδεκαέδρου καὶ τοῦ εἰκοσαέδρου) (58).

Das XV. Buch wird in drei Teile geteilt, welche Ergänzungen zur Lehre von den Polyedern enthalten.

Abschnitt 1. handelt über Konstruktionen von Körpern ineinander, wir Tetraeder in Würfel, Oktaeder in Tetraeder, Oktaeder

(54) Vgl. ausser der Lit. a.a.O. auch T. L. HEATH : *Greek mathematics*, 373-419.

(55) CANTOR, I_3, 358. Im Cod. Vatic. 190 sind das XIV. u. XV. Buch ganz von den übrigen getrennt.

(56) Vgl. HEIBERG : *Lit. Studien*, 154 ff., woselbst er die Gründe angibt, weshalb man das Buch XIV als einen Teil der Στοιχεῖα des EUKLID auffasste.

(57) Dieser wird auch in arab. Handschriften sowie in der lat. Übers. des GHERARDO V. CREMONA nach arab. Hdsch. als Autor des XIV. Buches genannt. Vgl. A. BJÖRNBO : *Abhdlgn. z. Gesch. d. math. Wiss.*, XIV, 140; B. M., VI, 3, 242 ff. (1905).

(58) HEIBERG : *Lit. Studien*, 156; *Euclidis opera*, V, 1 ff. (ed. HEIBERG). *Hermes*, 38, 321-33, 1907.

in Würfel, Würfel in Oktaeder u. Dodekaeder in einen Ikosaeder. Abschnitt 2 handelt über die Bestimmung der Zahl der Ecken (Raumwinkel) und Seiten. Der dritte Abschnitt endlich untersucht die Neigungswinkel der die regulären Polyeder berührenden Ebenen.

Im 7. Satze dieses Buches wird erwähnt, dass ISIDORUS VON MILET (59) der Lehrer des Verfassers (60) sei.

Hierzu möchte ich noch bemerken, dass G. KLUGE (61) nachzuweisen versuchte, dass das Buch XIV von drei Verfassern herrühre. Er gründet seine Untersuchung auf rein sprachlichen Vergleich.

Die arabische Überlieferung der Elemente

Die Elemente gelangten schon im 8. Jhdt. zu den Arabern. Der Chalîf AL-MANṢŪR (744-775) (62) erhielt eine Kopie des EUKLID; der Chalîf AL-MA'MŪN desgl. Manuskripte desselben. Im 9. Jahrhundert erschien die Übersetzung des ḤAJJĀJ B. YŪSUF (63). Sechs Bücher der Ma'mūn'schen Übersetzung befinden sich im Cod. Lugd. 399,1 (64). Im 10ten Jahrhundert erschien eine verbesserte Übersetzung von 'IṢḤĀQ B. ḤUNAIN, welche von THĀBIT B. QURRA nach griechischen Handschriften revidiert wurde. Die Bücher I-XIII sind Versionen von 'IṢḤĀQ B. ḤUNAIN und THĀBIT B. QURRA, während XIV und XV in der Übersetzung des QUSṬĀ B. LŪQĀ sind. Die abschliessende Bearbeitung haben wir von NASĪR AD-DĪN AT-ṬŪSĪ (65). Auch übersetzte SA'ĪD B. YA'QŪB AD-DIMISHQĪ einige Bücher, worunter das 10te sich befindet, sowie den Kommentar des PAPPUS

(59) E. W., B. V. 399 (CANTOR, I_3, 244 u. 301); ISIDORUS VON MILET war mit ANTHEMIUS VON TRALLES der Erbauer der Sophienkirche in Konstantinopel i. J. 537 n. Chr.

(60) Es soll dies DAMASCIUS VON DAMASCUS sein; CANTOR, I_3, 501.

(61) G. KLUGE : *De Euclidis elementorum libris qui ferunter XIV et XV* (Diss., Leipzig, 1891).

(62) WEIL : Geschichte der Chalifen, 2, 23-93.

(63) Vgl. KLAMROTH : Über den arab. Euklid, *Z. D. M. G.*, 35, 303-14 ; CANTOR, I_3, 702-03.

(64) Der arab. Text mit lat. Übersetzung ist herausgegeben von BESTHORN u. HEIBERG unter dem Titel : *Euclidis elementa ex interpretatione Al-Hadschdschadschi cum commentariis Al-Neirizi arabice et latine* (Copenhagen).

(65) H. SUTER : *B. M.*, VI, 3 ff., 1892; *Z. f. M.*, 1893, Lit. hist. Abtlg., 195. Auf weitere Einzelheiten komme ich später zu sprechen.

(B.N.S.?) (66) zu diesem (vorhanden in Paris, 2457, 5° u. 6°). Um das Jahr 1120 sind die Elemente von ATELHART VON BATH, einem englischen Mönche, aus dem Arabischen ins Lateinische übersetzt worden (67). Dass die Übersetzung nach einer arabischen Vorlage angefertigt wurde, dürfte durch das Auftreten arabischer Wörter darin erwiesen sein. Daran hat sich etwa 150 Jahre später eine Bearbeitung durch CAMPANO VON NOVARRA geschlossen, die zuerst in Venedig 1482 von ERHARD RATDOLT gedruckt erschienen ist. Eine andere erfolgte in Ulm, 1486, und eine dritte in Vicenza i. J. 1491 unter dem Titel *Preclarissimum opus elementorum Euclidis megarensis (?) una cum commentis Campani*, etc. (68). CAMPANO'S Übersetzung hängt wohl von der ATHELART's ab, was vor allem dadurch erwiesen zu sein scheint, dass in allen Manuskripten und Ausgaben die Definitionen, Postulate, Axiome und 364 Erklärungen wörtlich bei beiden übereinstimmen. Doch sind die Untersuchungen über die Quellen beider Werke, sowie die Abhängigkeit des jüngeren Bearbeiters von dem älteren noch nicht abgeschlossen. HEIBERG äussert in seinen *Euclidis opera* (V, Cf), dass ATELHART VON BATH als der Übersetzer, CAMPANO als der Kommentator zu gelten habe.

Endlich ist noch G. v. CREMONA (69) zu erwähnen, welcher ebenfalls die Elemente aus dem Arabischen übersetzt hat. Doch musste es als ein bedauernswerter Mangel der mittelalterlichen Übersetzungsliteratur angesehen werden, dass wir die 15 Bücher der *Euklidischen* Elemente in G. v. CREMONAS Übersetzung nicht kannten. Da gelang es nun A. A. BJÖRNBO (70) um die Wende des 19ten Jahrhunderts ein tiefgründiges Tatsachenmaterial zu sammeln, das genügend geeignet war, über die Geschichte der Elemente bei den Griechen und Arabern, sowie der Übersetzungstätigkeit G. v. CREMONAS einen Aufschluss zu verleihen. 1901 fand BJÖRNBO im Cod. Reg. 1268 eine Übersetzung von Buch X-XV der Elemente, welche aus dem Arabischen stammt.

(66) Vgl. hierzu besonders E. W., B. III, 235.

(67) Vgl. BUBNOV : *Gerberti opera mathem.* Berolini, 1899 ,174 (Über die Übers. der Elemente des EUKLIDES durch ADELARD).

(68) Vgl. M. CURTZE : *Anaritiusausgabe*, p. XIII, Leipzig, 1899.

(69) CANTOR, I_3, 907-08 ; M. STEINSCHNEIDER : Die europ. Übersetzungen aus dem Arabischen (*Wiener Sitzungsber.*, 149, 46 ff., 1904).

(70) A. A. BJÖRNBO : G. v. CREMONAS Übersetzung von ALKWARIZIMIS Algebra und EUKLIDS Elementen, *B. M.*, 6, 239-48, 1905.

Doch vermutete BJÖRNBO hier nur ein Fragment, da er glaubte, dass ursprünglich die ersten neun Bücher miteinbegriffen waren (71). Diese Übersetzung enthält auch die Vorrede des HYPSIKLES zu dem von ihm verfassten 14. Buche.

Auf Grund einer Reihe von Exemplaren derselben Übersetzung, welche BJÖRNBO im Jahre 1904 entdeckte, wird die Autorschaft G. v. CREMONAS endgültig nachgewiesen.

Ich führe des Zusammenhanges und der Bedeutung wegen die Exemplare an.

I. Vollständige Exemplare :

1) Cod. Paris 7216 (15. Jahrh.).
2) Cod. Bononiens. (Boulogne-sur-Mer) 196 (14. Jahrh.).
3) Cod. Brugens. (Brügge) 521 (14. Jahrh.).

II. Fragmente :

1) Cod. Reginens. 1268 (14. Jahrh.) Buch X-XV.
2) Cod. Digby 174 (Ende des 12. Jahrh.) Buch XI, 2-XIV; Prolog incl.).

(Fortsetzung folgt.)

Koblenz a/Rhein. Dr. A. G. KAPP.

(71) Vgl. *Abhdlgn. z. Gesch. d. math. Wiss.*, 14, 138-42, 1902.

Some aspects of the Introduction of Modern Science into China

1. One of the most significant aspects of modern history is the transformation which China is undergoing in reaction to the impact of Western civilization. Among the most vital and fundamental phases of this modernization is the introduction of Western science and the application of its methods to the study of the physical and social phenomena of the country and its civilization. This phase of what may be called the Chinese Revolution—to use the word in its largest sense—was, interestingly enough, the first to develop. It is the purpose of this paper to outline the history of modern science in China during the three and a half centuries that have elapsed since it was first introduced by the Jesuits in the seventeenth century. From the historical point of view the subject divides itself into four periods, each of which represents a distinct phase. The first period extends from about 1600 to 1800. The second period includes the greater part of the nineteenth century from 1800-1895. The third period covers the years from the close of the war with Japan to 1912. The final period covers the twenty odd years since the establishment of the Republic.

2. The first two periods, which cover a span of nearly three centuries, brought China in contact with Western science at two epochs of its development. Seventeenth and eighteenth century science was brought to China by Catholic missionaries; while nineteenth century science was introduced largely by Protestant missionaries. Neither of these groups would have accomplished as much as they did had it not been for the assistance of a number of Chinese scholars whose thirst for knowledge was left unsatisfied by their own science. They frequently sought out the "Ocean men" eager to learn more of their science and willingly assisted

them in the arduous tasks of translation. During the first period the Catholic missionaries and their Chinese co-workers translated and published no fewer than seventy-one works of a scientific character. Eleven of these dealt with science and machinery in general, twelve with arithmetic, geometry and trigonometry, forty-four with astronomy and four with geography (1).

3. The Jesuits made themselves welcome at the Ming and the Manchu Courts in Peking, largely because of their ability to make accurate astronomical observations and to correct the calendar which had fallen into error at the hands of the Moslem members of the Astronomical Bureau (Ch'in T'ien Chien — 2114, 11.208, 1640) (2).

4. Certain of the Jesuits including Fathers URSIS, SCHALL and VERBIEST were for many years in charge of the calendar as members of the Imperial Astronomical Bureau. Other evidence of the reception accorded the westerners and their science in this earlier period is found in the Ming history where it is

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(1) CORDIER, HENRI, *L'Imprimerie Sino-Européenne en Chine*, Bibliographie des ouvrages publiés en Chine par les Européens au XVII[e] et XVIII[e] siècles, Paris, 1901. For a fuller account of the publications of the Jesuits in China see *Notices Biographiques et Bibliographiques sur les Jesuites de l'Ancienne Mission de Chine, 1557-1773*. Tome I, XVI[e] et XVII[e] siècles, 561 pp., Chang-nai, 1932. For a description of the foreign and Chinese works on astronomy and mathematics which appeared in this and the following periods see WYLIE, A., *Notes on Chinese Literature*, (Shanghai, 1867) pp. 86-104. On the translation of ARISTOTLE into Chinese see CHANG EN LONG, " Europeans in China between the Ming and Ch'ing Dynasties." (in Chinese) *Library Science Quarterly*, Vol. IV, No. 3, 4, (Sept.-Dec. 1930) p. 452, and CLOUGHERTY, FRANCIS, " The Publications of the Catholic University of Peking," *Bulletin of the Catholic University of Peking*, No. 6 (July, 1929) pp. 69-72. The latter article tells of the recent publication in three volumes of the *Ming Li T'an* (7940, 6879, 10.688) a treatise on logic based on a compendium of scholastic philosophy used as a textbook in the college at Coimbra, Portugal which was translated by Father Furtado and Li Chih-Tsao.

(2) The numbers following Chinese words are the character-numbers given in H. A. GILES' *Chinese-English dictionary* (Shanghai, 1912). See HUMMEL, ARTHUR W., " Chinese, Japanese, and other East Asiatic Books added to the Library of Congress, 1930-31 " *Report of the Librarian of Congress*, 1931, pp. 269-271, for interesting evidence of the severe punishment meted out to officials responsible for miscalculations in drawing up the calendar and the bitter opposition in certain Chinese quarters to the appointment of Jesuits to the Astronomical Bureau. For a select bibliography and critical comments on the development of astronomy in China from ancient times see VACCA, G., "Some Points on the History of Science in China", *Journal North China Branch Royal Asiatic Society*, N. S. Vol. 61 (1930), pp. 10-19.

written that the " majority of the books which they (the Jesuit missionaries) have written are what the Chinese have not yet treated of. " (3).

5. With respect to the nature and extent of the influence of Western science in the seventeenth and eighteenth centuries on Chinese thought in general and their indigenous science in particular it is impossible, at the present stage of incomplete research in the field, to make a satisfactory appraisal. Differences of opinion exist. For example, the influential writer LIANG CH'I-CH'AO (4) believed the missionaries profoundly stimulated the literati of those centuries " opening to (them) a hitherto unknown world of ideas and providing (them) with a better logical method than China had yet known." With this statement the equally eminent scholar HU SHIH disagrees (5).

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(3) For foreign names see *Index A*. MOULE, A. C., " The first arrival of the Jesuits at the capital of China," *New China Review*, Vol. 4, p. 455. The Jesuits of course adhered to the Ptolemaic system; " ... and although COPERNICUS, TYCHO BRAHE and even KEPLER are frequently mentioned by name in connection with their labors, there is only slight allusions to the systems which have received their designations from these astronomers." Quoted from WYLIE, *op. cit.*, p. 88.

(4) For Chinese Names see *Index B*.

(5) LATOURETTE, K. S., *A History of Christian Missions in China*, (New York, 1929) p. 196; BERNARD, HENRI, S. J., " Whence the Philosophic Movement at the Close of the Ming (1580-1640)? " *Bulletin of the Catholic University of Peking*, No. 8 (December, 1931) pp. 67-73. Father BERNARD attempts to build up a case in support of the thesis that MATTEO RICCI perhaps influenced KU YEN-WU, the reputed founder of the Neo-Han school, the precursor of the modern philosophical renaissance and opponent of Sung Confucianism. He points out that RICCI went directly to the Han texts long before KU did. " Not content with securing a hearing from the Confucianists by rejecting idolatry, RICCI acted as innovator, and with the texts of CONFUCIUS in his hand, overthrew the insinuating exegeses of the commentators of the Sung dynasty..." (p. 70). While BERNARD does not specifically say so it appears that RICCI wished to strip Confucianism bare of the Buddhistic and Taoistic influences which the Sung philosophers had introduced in order to prepare the way for a possible synthesis of Confucianism and Christianity. The critical methods which he employed to achieve this purpose were perhaps of influence on KU YEN-WU and those who followed him. BERNARD put forth as other arguments that " ... nearly all the scholars of the neo-Han school... passed through the discipline of the mathematical sciences brought to China by the Jesuits." while, his faithful disciples exercised great influence on the Tung Lin (12.248-7157) school (p. 73). On the other hand it should be pointed out that the Chinese scholars had developed methods of research prior to the arrival of RICCI in China which were in advance of those prevailing in Europe at that time. Moreover, the political events of the time marked by the decline of the native Ming dynasty and the conquest of China

6. Nevertheless, works published during and after this period of Catholic missionary activity, particularly in the field of mathematics, disclose marked western influence. For example, in the *Shu Li Ching Yün* (10,075, 6879, 2133, 13.833) published in 1723 by Imperial order, there is a comprehensive summary of mathematics, incorporating such Western developments as had found their way to China. It contains the earliest description of European algebra and the earliest complete treatise on logarithms in Chinese (6).

Also there was published in 1875 a large collection of mathematical works, the *Pai Fu T'ang Suan Hsüeh Ts'ung Shu*, (8556, 3617, 10.760, 10.378, 4839, 12.039, 10.024) wherein marked western influence derived in part from this first period is readily discernible (7).

7. The scientific work of the Jesuits appears to have started a revival of learning with respect to the native sciences, particularly mathematics. During the greater part of the Ming dynasty (1368-1644) native science had fallen into a low state; mathematical and astronomical studies being in abeyance resulting in many errors in the calculations of the calendar. It was the demonstrated superiority of the Jesuit methods which won for them the recognition of the Court [as we have seen.] The translation of western mathematical and astronomical works stimulated in the native scholars an interest in their own science as shown by the number of works that commenced to appear during the seventeenth century and continued to be put forth from then on into the nineteenth century, when renewed contacts with the West caused a resurgence of interest which has continued with vigor to the present time (8).

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by the alien Manchus were a sufficient cause influencing a large number of literati to question the validity of Sung Confucianism. In this connection see HU SHIH, "The Chinese Renaissance," in the *China Year Book*, 1924, pp. 633-651.

(6) PEAKE, C. H., *Nationalism and Education in Modern China*, (New York, 1932) pp. 215, 216. Also see VAN HÉE, LOUIS S. J., "Première mention des logarithmes en Chine," *T'oung Pao*, Vol. 15 (1914), pp. 454-457 and WYLIE, *op. cit.*, pp. 89, 90. The first mention of logarithms appeared in the book *T'ien Pu Chên Yüan* (11.208, 9485, 589, 13.700) about 1650 by HSIEH FÊNG-TSO, a student of the Polish Jesuit SMOGOLENSKI.

(7) VAN HÉE, Père L., "Bibliotheca Mathematica Sinensis Péfou," *T'oung Pao*, Vol. 15, (1914), pp. 111-164.

(8) One of the most valuable of the recent studies is the first volume of the *Chung Kuo Suan Hsüeh Shih*, (2875, 6609, 10.378, 9893) "A History of Chinese

8. ALEXANDER WYLIE writing in the middle of the last century stated that, due to the fact that mathematical studies having been long dormant in China, when the Jesuits arrived, " ... few if any of the native scholars knew what the ancient works contained, and the missionaries were left to teach many things as new, which had been well understood in China for ages past. The consequence was, the introduction of a new nomenclature in place of the old established terminology, and the latter having since been restored by native mathematicians, there are now two systems of terms, both of which being partially or simultaneously adopted in many modern treatises, have introduced a looseness and inaccuracy of phraseology, little to the advantage of mathematical studies " (9).

9. Père VAN HÉE, an outstanding authority on Chinese mathematics has critically evaluated the nature of this influence in his comments on YÜAN YÜAN's collection of biographies of mathematicians (10).

Therein he observes that the " Chinese display no special taste for and no real aptitude in the study of pure mathematics. To them it is the calendar and the observations of celestial phenomena that prove the most interesting, and in these biographies there is twenty times as much attention paid to astronomy as to any other subject " (11).

It is his conclusion that, " Not one of the learned men of China succeeded in completely assimilating European methods " (12).

Mathematics " published by the Academia Sinica. This volume covers the development to the time of the introduction of European mathematics in the latter part of the Ming dynasty.

(9) *Notes on Chinese Literature*, p. 95.

(10) VAN HÉE, Père L., " The Ch'ou-jên ch'üan of YÜAN YÜAN." *Isis*, 1926, pp. 103-118. For further observations by the same author on Chinese mathematics see his article, " Le Classique de l'île maritime, ouvrage Chinois du III^e siècle." *Quellen und studien zur Geschichte der Mathematik Astronomie und Physik*, Band II, Heft 3, 1932, pp. 256-280. He includes a select bibliography of studies in western languages on the history of Chinese mathematics. Also in this connection see VACCA, G. *op. cit.*, and SMITH, D. E. " Unsettled questions concerning the mathematics of China," *Scientific Monthly*, Sept. 1931, pp. 244-50.

(11) *Ibid.*, p. 106.

(12) *Ibid.*, p. 117. VACCA (*op. cit.*, p. 15) writes that no Chinese scholars of this period were " ... able to have an original conception of Western Science, or to reconstruct it." For suggestive attempts to explain why the various sciences failed to develop in China consult FUNG, YU-LAN, " Why China has no Science,"

10. With the retarding of missionary activity, due in part to the repeated persecutions of the eighteenth century, direct contact with western scientific developments was largely cut off only to be renewed again in the middle of the nineteenth century by the Protestant missionaries. During the interim, the traditional complacency and attitude of superiority of the Chinese literati with respect to all alien cultures tended to reassert itself. YÜAN YÜAN writing in his biographies of mathematicians, which was first published in 1799, asserted that, " It is evident to those who are well versed in Chinese mathematics that Europe has added nothing new." He believed that European mathematicians simply developed fundamental principles and formulae which they had originally acquired from the Chinese (13).

11. However meager the results of the Jesuits contacts may have been from a strictly scientific point of view, from the historical point of view they were markedly influential in hastening the introduction of western science during the nineteenth century. The more intimate relations with western nations which followed the signing of the treaties of 1842-44 and the opening of the ports of Canton, Amoy, Foochow, Ningpo and Shanghai to foreign residence and trade, led to a greatly increased desire on the part of the officials and literati to learn more of the science, the geography and the general customs and practices of western countries.

12. A number of compendious works appeared to meet this demand, among which the most influential was perhaps WEI YÜAN's *Hai Kuo T'u Chih* (3767, 6609, 12.128, 1918) or " Descriptive and Historical Geography of Foreign Countries." Much of the materials for the work were amassed by Commissioner LIN at Canton "... from the writings of foreigners in Chinese and translations made from English newspapers and other works..."

International Journal of Ethics, Vol. 32 (1922) pp. 237-263; DUBS, HOMER H., " The Failure of the Chinese to produce Philosophical Systems." *T'oung Pao*, Vol. 26, (1929) pp. 96 ff.; HU SHIH, *The Development of the Logical Method in Ancient China*. (Shanghai, 1922) passim; MASPERO, HENRI, *La Chine Antique*. (Paris, 1927) pp. 607-621; DUYVENDAK, J. J. L., " A Literary Renaissance in China," *Acta Orientalia*, 1923, passim; and LIANG CH'I-CH'AO, " K'ê Hsüeh Ching Shên Yü Tung Hsi Wen Hua," (6089, 4839, 2133, 9819, 13.522, 12.248, 4031, 12.633, 5001) (" The Scientific Spirit in Eastern and Western Civilizations ") *K'ê Hsüeh (Science)*, Vol. 7, No. 9 (Sept. 1922) pp. 859-870.

(13) VAN HÉE, L., " Le Classique de l'île maritime...," p. 259.

WEI YÜAN added from the materials at his disposal including information derived from the works of the Catholic missionaries of the seventeenth and eighteenth centuries. The last chapter discusses the construction of ships of war, of steam vessels, fire-arms, astronomy, etc. It was first presented to the public in 50 books in 1844.. It became quite popular, an enlarged edition in 60 books appearing in 1849, while a third edition of 100 books appeared a few years later (14).

13. Scholars such as LI SHAN-LAN, HSÜ SHOU, HSÜ CHIEN-YIN and HUA HÊNG-FANG, whose interest in science was aroused through reading such works as this as well as the original scientific works of the earlier missionaries, were to prove of invaluable assistance to Protestant missionaries, such as ALEXANDER WYLIE and W. A. P. MARTIN in the introduction through translation of the science of their century.

14. JOHN FRYER, who for many years was associated with these Chinese as director of the translation bureau of the Kiangnan arsenal in Shanghai after 1868, informs us that they (with the exception of LI SHAN-LAN) were members of a little coterie of scholars at Wusih near that port, who sought eagerly to learn the secrets of nature and read with avidity the works of the Jesuits as well as native Chinese works on mathematics and astronomy (15).

A member of the group while on a visit to Shanghai chanced upon a copy of Dr. HOBSON's translation of a work on natural philosophy, the *Po Wu Hsin Pien* (9372, 12.777, 4574, 9178) published in 1855. The book proved to be a revelation to the members of the group enabling them to leap across the two centuries from seventeenth to nineteenth century science. They extemporized apparatus with which to perform the elementary experiments described in its pages and wrote papers on their observations. These papers accumulated in the home of the HSÜ's where, unfortunately, they were lost when the house was

(14) WYLIE, ALEXANDER, *Notes on Chinese Literature*, p. 53; KO KUNG-CHÊN *Chung Kuo Pao Hsüeh Shih* (2875, 6609, 8731, 4839, 9893) (" History of Chinese, Journalism ") (2nd Ed. Shanghai, 1928), pp. 97, 99.

(15) " Science in China," *Nature*, May 5, 1881, Vol. 24, pp. 9-11. LAN T'IAO-FU " How to accept Western Science," *Chinese Social and Political Science Review*, Vol. XI, No. 4 (Oct. 1927), pp. 567-576.

destroyed in the course of the T'ai-p'ing rebellion. In 1862 these men and a few others (such as LI SHAN-LAN and YUNG WING) who knew something of the West and its science, were attached to the *yamen* of the great Viceroy TSÊNG KUO-FAN who was then bringing to a successful close his campaign against the T'ai-p'ing rebels. They served as his advisors in his efforts to strenthen the Empire through the introduction of Western applied science.

15. LI SHAN-LAN, the foremost Chinese mathematician of the nineteenth century, who likewise had his interest aroused in Western science through reading the earlier Jesuit translations, made his way to Shanghai, shortly after the opening of that port to foreign residence and trade, in the hope of meeting there Westerners and learning directly from them more of their science. There he met ALEXANDER WYLIE and was soon at work collaborating with him in completing the translation of EUCLID's Geometry, the first six chapters of which had been translated by MATTEO RICCI and HSÜ KUANG-CH'I some 250 years earlier. He also assisted WYLIE in translating HERSCHEL's *Outlines of Astronomy*, DE MORGAN's *Algebra* and LOOMIS' *Analytical Geometry* and *Differential and Integral Calculus*. He met the Rev. Dr. EDKINS and assisted him in the translation of WHEWELL's *Mechanics*.

16. His acquaintance with the scientific terminology created by the Jesuits made him a valuable assistant. These nineteenth century scholars profited considerably by the pioneering efforts of the Jesuits in rendering western scientific terms into Chinese as JOHN FRYER readily admitted. LI's ability was quickly recognized by reforming officials, who appointed him Professor of Mathematics at the *T'ung Wên Kuan* (12.248, 12.633 6353) or Imperial College of Peking when instruction in the sciences was introduced into that institution in 1865 (16).

17. Further evidence of the influence, from the historical point

(16) MARTIN, W. A. P., *Cycle of Cathay*, pp. 369 ff. I find myself in disagreement with VACCA's statement (*op. cit.*, p. 15) that WYLIE and LI SHAN-LAN did not contribute to the diffusion of western science in China. While it may be true that their translation work had to be rejected by a later generation of Chinese who had come, through study abroad, into more direct contact with western science, and who had evolved a more accurate terminology, nevertheless these pioneers as the Jesuits before them played an historic role in this introductory period, the significance of which I have attempted here to disclose.

of view, of the first period of the introduction of western science by the Jesuits on the nineteenth century literati is seen in the publication in 1865 by the Viceroy TSÊNG KUO-FAN of a translation of the fifteen chapters of EUCLID's Geometry. The circumstances resulting in the translation into Chinese of this work are most interesting as a reflection of the spirit of the times. These are recounted in the five prefaces appearing in the edition which TSÊNG KUO-FAN ordered printed in 1865. The prefaces were written by TSÊNG (actually composed by his son HUI-MIN), MATTEO RICCI, HSÜ KUANG-CH'I, ALEXANDER WYLIE and LI SHAN-LAN.

18. TSÊNG informs us that :

" The first six chapters of the *Chi Ho Yüan Pên*, (786, 3941, 13700, 8846) (EUCLID's Geometry) were taught to HSÜ KUANG-CH'I [a prominent official at the close of the Ming dynasty and a member of a wealthy and influential family] by the foreigner MATTEO RICCI. During the Hsien Fêng period (1851-1862) L SHAN-LAN of Haining began, with the Western scholar ALEXANDER WYLIE, the translation of the last nine chapters and the correction of the first six chapters. Thus was the work (begun 250 years earlier) completed. HAN LU-CH'ING of Sunkiang published it, but shortly thereafter the woodblocks were burned in the course of the T'ai-p'ing rebellion. LI SHAN-LAN, who worked under me in the Anking army, showed me the work saying : " This work is indispensable to mathematicians. It will be lost if it is not printed at once. ' After I had moved my headquarters to Chinling (Nanking) I ordered LI to correct the last nine chapters and to have them printed... and to do the same for the first six chapters as well. " TSÊNG concluded his preface by pointing out that the inherent defect in Chinese mathematics lay in its complete absorption in specific practical functions resulting in a failure to discover the underlying principles ; while EUCLID's Geometry dealt not with method, but with such fundamental principles (17).

(17) PEAKE, C. H., *op. cit.*, pp. 5, 6, and 216 notes 7, 8. There is in the DAVID EUGENE SMITH collection of works on mathematics at Columbia University a manuscript called the *Chi Ho Yüan Pên*. As the prefaces explain, it is a translation of the first six chapters of EUCLID, orally explained by MATTEO RICCI and put in its written form by HSÜ KUANG-CH'I. The work was then printed in 1607. A postface by HSÜ relates that after RICCI's death, a printed copy with corrections in his own handwriting was found. Assisted by two friends HSÜ prepared a revised edition in 1611 of which the SMITH manuscript is a copy. There is also a manuscript copy of this work in the SEIKADO (2179, 1158,10,760) Library in Tokyo.

19. Another and more indirect influence of the earlier contacts in paving the way for the introduction of nineteenth century science is seen in the arguments presented in the memorials of officials advocating reform. These arguments recalled the welcome accorded western science as introduced by the Jesuit missionaries. Thus Prince KUNG, President of the newly organized bureau for the control of foreign affairs (Tsungli Yamen 12.010, 6879, 12.831, 7751) stated in a memorial that the Emperor during the K'ang Hsi period (1662-1723) " ... was deeply versed in Western science." Another common method to win over opposition was to flatter the conservatives by asserting as did KUNG in a memorial that " ... Western sciences borrowed their roots from ancient Chinese mathematics. Westerners still regard their mathematics as coming from the Orient. It is only because of the careful enquiring nature of the Westerners that they are good at developing something new out of the old... China invented the method, Westerners adopted it..." (18)

20. Prince KUNG continues :

" During the K'ang Hsi period mathematical studies were connected with the astromonical board... In former times the farmers and soldiers knew astronomy, but in later times its study was prohibited, only a few knowing it [those connected with the court]. During the K'ang Hsi period the prohibition against astronomical studies was removed with the result that a greater and more widespread interest in it developed. Scholars who studied the Classics knew something about mathematics as well, and there were many works published which dealt with it in detail " (19).

21. The immediate events leading to the introduction of nineteenth century science centered in the unsuccessful wars with the Westerners in 1839-42 and 1858-60. The close of the second clash, marked by the signing of the humiliating treaties of 1860, left a number of the more enlightened Chinese and Manchu officials deeply concerned about the future safety of the Empire. Their faith in the fundamental validity and superiority of Confucian civilization was scarcely shaken, but it was painfully apparent

(18) PEAKE, C. H., *op. cit.*, p. 4. These ideas Kung no doubt derived from a reading of YÜAN YÜAN's Biographies. (See above note 10.)

(19) *Ibid.*

that their methods of warfare were hopelessly antiquated. First efforts at modernization, therefore, consisted in the establishment of arsenals at such strategic points as Shanghai and Foochow, for the purpose of manufacturing modern armaments and the construction of modern vessels of war. The spirit which animated these reforming officials was later well epitomized by the progressive Viceroy CHANG CHIH-TUNG as follows: *Chung hsüeh wei t'i; hsi hsüeh wei yung* (2875, 4839, 12.521, 11.025, 4031, 4839, 12.521, 13.449), "Western learning should be adopted for practical purposes, but Chinese learning should remain the guide." This narrow pragmatic conception of the value of Western science persisted in the minds of reforming officials into the present century. They were unaware of the existence of pure science as an independent body of learning, nor did they possess any appreciation of its spirit and its method.

22. Nevertheless, foreigners in the employ of the government, such as MARTIN, BILLEQUIN, FRYER and GIQUEL, had little difficulty in convincing enlightened officials, for example, Prince KUNG and Viceroys LI HUNG-CHANG, TSÊNG KUO-FAN and TSO TSUNG-T'ANG, of the necessity for instruction in mathematics, physics and chemistry as prerequisites for the designing and construction of modern armaments as well as the study of astronomy for the purpose of navigating vessels of war. Thus it came about that courses in these subjects were introduced, after 1865, into the arsenals and the Imperial College of Peking. Within a quarter of a century the value of western science had become sufficiently apparent to bring about the most fundamental change in the centuries-old civil service examinations that had occurred since the Ming Dynasty. This change by which science, particularly mathematics became an optional subject in an examination which the candidate voluntarily chose, took place in 1887. While it had little immediate effect, the psychological importance of the event should not be overlooked. The old body of learning, crystallized in the Chinese Classics, and made enduring through some twenty centuries by means of the examination system, for the first time found a competitor in the new body of learning from the scientific West.

23. Of prime importance in introducing western science to the Chinese, other than the employment of Westerners as instruc-

tors in the various newly established schools and at the arsenals, where courses in science were given, was the translation into Chinese of western scientific books. It was in the first place instrumental in giving to the reforming officials of this period some concept of the depth and value of western science and in the second place it won over increasing numbers of literati outside official circles and paved the way for the more thorough-going reforms of a later generation. The Rev. J. Jackson writing in 1893 stated : " We sometimes have men call upon us who are very well versed in science and mathematics, who have obtained their knowledge through the medium of books alone " (20).

JOHN C. FERGUSON, writing in 1892, pointed out that great unrest existed in Chinese literary circles, and that there was an " ... immense sale of all kinds of mathematical and scientific books " (21).

24. The foremost centre for the translation of western scientific works was the translation bureau of the Kiangnan arsenal. In the period from 1870 to 1904 this bureau published 177 works, a majority of which were translations : 88 English, 19 American, 3 French, 5 Japanese and 2 German. The range of subjects was wide including not only works on chemistry, physics, astronomy, mathematics, telegraphy, navigation, ship construction, etc. but also a few works on government and law. The volumes were well illustrated and beautifully printed (22).

25. The sale of these works was surprisingly large and indicates a widespread interest (23).

In February 1876 FRYER started a monthly publication known as the *Chinese Scientific and Industrial Magazine* (Ko Chih Hui Pien — 6029, 1832, 5215, 9178) for the purpose of disseminating

(20) JACKSON, J., " Objects ,Methods and Results of Higher Education in our Mission Schools," *Chinese Recorder*, XXIV (1893), pp. 7 et seq.

(21) FERGUSON, JOHN C., " Higher Education in China," *Chinese Recorder* XXIII (1892), p. 154.

(22) *Kiangnan Chih Tsao Chü Chi* (1208, 8128, 1911, 11.624, 2955, 923) (History of the Kiangnan Arsenal), pp. 15-23, 31 A. The Chinese Library of Columbia University has 107 of these works.

(23) By 1879 the ninety-eight works then published had obtained a sale of 31,111 works in 83,454 volumes. See FRYER, J., " Science in China " *Nature*, vol. 24 (May 19, 1881), pp. 54-57. FRYER states that many of these works went to Japan where they were no doubt of assistance to the Japanese in determining their own scientific terminology.

in a popular manner scientific information among the literati. Aiming to appeal to the learned, it was written in the dignified classical, or *wen-li* style. It was the forerunner of later popular science journals written for the most part in the vernacular in order to reach a wider circle of readers (24).

26. While the Shanghai arsenal translation bureau produced the greater bulk of translations in this period we find also that the Imperial College produced a number of works on chemistry, physics, mathematics and astronomy (25).

Moreover the Protestant missionaries who as we have seen resumed the task of translation begun by the Jesuits continued through the period to produce works of a scientific nature. Among such works were : Dr. HOBSON's popular works on Western medicine published during the middle of the century including a work on Anatomy (*Ch'üan T'i Hsin Lun*, 3176, 11.025, 4574, 7475), a treatise on Western medicine (*Hsi I Lüeh Lun* 4031, 5380, 7564, 7475); on therapeutics (*Nei K'ê Hsin Shuo*, 8177, 6089, 4574, 10.164) and a work on the medical treatment of women and children (*Fu Ying Hsin Shuo*, 3749, 13.318, 4574, 10.164); W. A. P. MARTIN's *Physics* (*K'ê Wu Ts'ê Suan*, 6089, 12.777, 11, 698, 10.378) 8 Vols. 1884; Dr. HOLBROOK's *Biology* (*Tsêng T'u Huo Wu Hsüeh*, 11.726, 12.128, 5324, 12.777, 4839) 1890; A. WILLIAMSON and Rev. Dr. EDKIN's *Botany* (*Chih Wu T'u Shuo*, 1849, 12.777, 12.128, 10.164) 1859; Dr. H. T. WHITNEY's, *Grey's Anatomy* (*T'i Hsüeh Hsin Pien*, 11.025, 4839, 4574, 9178) c. 1857; and Dr. S. A. HUNTER's *Squire's Manual of Therapeutics and Pharmacopoeia*, (*Wan Kuo Yao Fang* 12.486, 6609, 12.958, 3435) 1890. Many of these works were designed as textbooks for use in the rapidly increasing number of missionary schools (26).

27. While the Protestant missionaries took the lead during the nineteenth century in introducing to the Chinese Western civilization and its science, the Catholic missionaries were by no means inactive from a strictly scholarly and scientific point of view. The Jesuits returned after 1844 and considered the desirability

(24) See KO KUNG-CHÊN, *op. cit.*, pp. 115 ff.

(25) See *T'ung Wen Kuan T'i Ming Lu* (12.269, 12633, 6353, 11.009, 7940, 7386) (The T'ung Wen Kuan Catalogue), No. 5, (1893), pp. 55-57.

(26) CLAYTON, G. A., *A Classified Index to the Chinese Literature of the Protestant Churches in China*, (Shanghai, 1918), pp. 173-193.

of reestablishing the scientific mission to Peking which in the seventeenth century had been largely influential in gaining for them the favor of the Court. However, due to divided counsels among them and the prevalence of anti-foreign sentiments at the Chinese Court coupled with the fact that they were no longer dependent on official favour as formerly because of the toleration clauses in the treaties they decided not to return to Peking.

28. They made their headquarters instead at Zikawei (Hsü Chia-hui, 4748, 1139, 5190) near Shanghai on the ground given to them by the renowned seventeenth century Jesuit Hsü Kuang-ch'i (27). In 1869 they began to collect materials for a museum of Natural History which has since grown to be one of the leading institutions of its kind in China, with much published material to its credit. After 1872 when they decided to make Zikawei a research centre the Jesuits established there one of the best known and most useful meteorological observatories in the whole Far East which issues daily weather reports and forecasts. They have also there a seismological station. Their large printing establishment publishes not only literature of a religious character but also scientific books and periodical literature including Annuaires, Bulletins, and Memoirs.

29. The Jesuits have likewise resumed their scholarly studies of Chinese history and civilization. Among works of this type perhaps the best known is the series " Variétes Sinologiques " which began in 1892 and now numbers no less than fifty-nine monographs. Apart from this series they have published a score of other works of a scientific character (28).

30. At another important Jesuit center in Sienhsien, Chihli (now Hopei) province scholarly work has been carried on particularly by Fathers Couvreur and Wieger who have translated extensively Chinese classical and historical literature. Another outstanding work is the *Vocabulaire des sciences mathématiques*,

(27) Latourette, *op. cit.*, p. 235.

(28) *Catalogus Librorum Lingua Sinica Scriptorum*, Zikawei, 1917; *Catalogue les ouvrages Européens*, Imprimerie de l'Orphelinat de T'ou-Sè-Wè, Zikawei, 1927. The 59th monograph is entitled *Notices Biographiques et Bibliographiques sur les Jesuits de l'Ancienne Mission de Chine*, 1552-1773. Tome I, XVI^{e} et XVII^{e} siècles, 561 pp., 1932. The work gives the biographies and bibliographies of 248 Jesuit missionaries.

physiques et naturelles by P. CHARLES TARANZANO, S. J. in three volumes (Sienhsien, 1921-23) (29).

31. Other achievements by the Catholic missionaries in this and subsequent periods are the excellent scholarly studies of Chinese mathematics made by P. LOUIS VAN HÉE; the studies made in natural history by the Lazarist ARMAND DAVID who established a museum at Peking which was later transferred to the Chinese government; the geological explorations carried on by the Jesuit E. LICENT in Mongolia, who likewise established a museum in Tientsin; and the important archeological work of Fathers LICENT and TEILHARD DE CHARDIN (30).

32. While the Catholics founded many schools scientific instruction was not emphasized. "Little or no attempt was made," writes K. S. LATOURETTE, "to introduce the Chinese to Occidental learning beyond that directly connected with the essentials of the Catholic faith" (31). Nevertheless science instruction was provided for in certain institutions as at the Université l'Aurore, established by the Jesuits at Shanghai in 1903; at the L'Institut des Hautes Études Industrielles et Commerciales founded also by the Jesuits at Tientsin in 1922; and at the Catholic University of Peking, established in that city by the American Benedictines in 1925. The members of the staff of the Catholic University have emphasized the study of the history of foreign religions and missions in China and a number of valuable monographs have appeared. The University publishes a *Bulletin* and a sinological serial, the *Fu Jên Hsüeh Chih* (3627, 5627, 4839, 1918).

33. The problem of terminology has of course been an ever present one with those translating western works and one which has only begun to approach a solution within the past twenty years. The difficulties of the task in this earlier period gave rise to much confusion in the terms employed with little visible progress toward the establishment of a standardized terminology in a single scientific field. Indeed the difficulties of the task seemed well nigh insurmountable to some who asserted that

(29) *Catalogus Librorum Typographiae Sienhsien*, 1927.

(30) For a further account, of the work of Fathers LICENT and CHARDIN, see below § 88, and note 79.

(31) A History of Christian Missions in China, p. 236.

the Chinese language was incapable of incorporating and accurately expressing the terms employed by western scientists. Their solution was to teach the students entirely through the medium of a western language, usually English. However, the translators most proficient in the use of the language such as WYLIE, MARTIN and FRYER found it a fit though difficult medium in which to express western scientific terms and proceeded to the task of transplanting western science in Chinese soil with zest, encouraged as FRYER acknowledged by the pioneering efforts of the Jesuits before them (32).

34. FRYER writing in 1881 from a background of abundant experience, lays down in order of importance the methods of establishing a term : 1. Try to find an equivalent term in a Chinese work; 2. If unable to do so, then try to discover if it is in current use; 3. Failing that, make a new character, or give a new meaning to an existing or uncommon character; or invent a descriptive term; 4. and finally, these methods all failing, phonetically transliterate the term into Kuan Hua, or Mandarin. However, his advice was by no means always followed, the easy method of transliteration being frequently employed (33).

Many of the earlier translators while possessing considerable knowledge of the language were not trained scientists, thus the terms which they selected came to appear in the eyes of later translators as quite unsuitable. For example as late as 1917 textbooks in use called $KMnO^4$ " extra strong manganese alum of potassium " as the first chemistry text published about 1870 gave the general name for salt as alum (34).

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(32) FRYER, J. " Science in China," *Nature*, vol. 24, pp. 54-57. Also consult his essay « Scientific Terminology.... » in *Records of the General Conference of the Protestant Missionaries of China* (Shanghai, 1890), pp. 531-549.

(33) See the Rev. G. A. STEWART's comments in the *Chinese Recorder* vol. 25, pp. 88-90. For a general criticism see an article by GUSTAVE SCHLEGEL, " Scientific Confectionary " (*T'oung Pao*, Vol. V, pp. 147-151), where he warns against translating the many unscientific terms used by western scientists that were inherited from the earlier pseudo-science of the west, and recommends that they find more accurate descriptive terms.

(34) See WILLIAM H. ADOLPH, " Synthesizing a Chemical Terminology in China," *Journal of Chemical Education*, vol. 4, no. 10 (Oct. 1927), pp. 1233-1240. VACCA (*op. cit.*, p. 51) writes that WYLIE's attempt " ... to translate with symbols half European and half Chinese the elements of differential and integral calculus found no followers."

35. Before the close of the period the need of standardizing terms had become sufficiently obvious to result in the formation of committees for the purpose. In 1890 the China Medical Missionary Association held its first meeting and a committee on terminology was appointed which, however, did not hold regular meetings until a decade later. At the 1877 Missionary Conference a permanent committee on schools and textbooks was appointed with JOHN FRYER as chairman and general editor. Under his direction efforts at standardization of terms used in textbooks were made. However, the period came to a close with very little real progress made in this direction. Another generation was to pass before marked achievement both in standardization of terms and in the formation of an adequate terminology could be noted.

36. The third period, extending from the close of the unsuccessful war with Japan in 1895 to the establishment of the Republic in 1912, was characterized by a broadening grasp of the nature of modern science in both its applied and experimental aspects. In the second period, as we have seen, the primary aim of reforming officials in bringing about instruction in mathematics and certain of the physical sciences was to strengthen the defense forces of the Empire. The sudden and humiliating defeat at the hands of the Japanese, toward whom they had traditionally held an attitude of cultural superiority, but who had, however, been modernizing their empire in a more efficient and thorough-going manner, clearly revealed to them the narrowness and inadequacy of their own reform program. In the atmosphere of pained surprise and alarm which followed the war, reformers both within and without official circles came boldly forth advocating in memorials to the Throne more fundamental military, educational and administrative changes. In these memorials we find criticisms of the early reform efforts and suggestions involving the translation of more up to date scientific works; the establishment of more laboratories that students might do actual experimental work, which had been largely denied them in the past because of the lack of scientific apparatus; the sending of more students abroad for scientific training, and, finally, the application of scientific technique to the exploitation of China's natural resources as well as to the

improvement of its commerce, industry and agriculture (35).

37. The exploitation of the country's natural resources was held to be of prime importance by the reformers, for as SHÊNG HSÜAN-HUAI, Director-general of the China Merchants' Steam Navigation Company, pithily summarized in a memorial in 1896, " The way to build a strong nation is to train good soldiers, but to train good soldiers plenty of money is necessary and to have sufficient funds trade and industry must be developed " (36).

These memorials prepared the way for the reform edicts that were soon to follow, which provided for the establishment of mining, agricultural, industrial and technical schools in general.

38. Of prime significance in paving the way for reform was the publication in the early part of 1898 of a collection of essays edited by the prominent statesman Viceroy CHANG CHIH-TUNG under the title " An Exhortation to Learning." It was a consummate summary of the reform tendencies of the time. The work was given Imperial endorsement in the same year and over a million copies are estimated to have been sold or distributed throughout the Empire. These essays while advocating the retention of the Classics as the basis of education vigorously plead for the introduction of " western studies " particularly of a scientific nature as a means for enriching and strengthening the Empire. They asserted also that not only should the military forces be strengthened, but more schools should be established in which Western sciences were to be taught; the examination system should be altered to permit the acceptance of western sciences in general; more western works should be translated; agriculture, industry and commerce should be scientifically studied; and finally railroads should be built and mines opened. Thus, science to came be conceived of not merely as a means by which to reform the calendar or forecast eclipses, as during the seventeenth century, or to modernize the defense forces of the Empire, as in the generation following 1860, but also as means for increasing the wealth and well-being of the Empire.

39. During the Hundred Days of Reform, June to September, 1898, progressive officials and literati under the leadership

(35) PEAKE, C. H., *op. cit.*, pp. 25 et seq.

(36) *Kuang Hsü Tung Hua Hsü Lu*, (6389, 4772, 12.248, 5005, 4773, 7386) (Official documents for the period 1875-1908), *chüan* 136, pp. 10-14.

of K'ANG YU-WEI and LIANG CH'I-CH'AO gained the support of the Emperor and many of the plans put forth in the preceding three years in memorials were promulgated with Imperial sanction. However, a period of reaction set in with the return to power of the Empress Dowager TZ'Ŭ-HSI which persisted through the Boxer uprising of 1900. The march of the Allied troops to Peking and the flight of the Court to Shensi once again humiliated the Manchus and lowered their prestige in the country. It became apparent even to the reactionaries that the preservation of the dynasty itself lay in reform. Thus it came about that beginning in 1901 a series of reform edicts were proclaimed which launched the old Empire on a program of administrative, economic, and educational reform, similar to that which Japan had entered upon thirty years before.

40. In August, 1901, a decree was issued providing for the abolition of the old military examinations. In the following month a decree was sent forth providing for the beginnings of a modern educational system in which scientific studies were to have their place along with Classical studies. About the same time a decree was issued authorizing students to go abroad for study and promising them upon their return the privilege of taking examinations for official degrees. Following this decree and the abolition of the old civil-service examination (1905) students went abroad by the thousands each year, eventually returning with a fuller grasp of the elements of western civilization including its science, and confident that their country's salvation was to be attained through modernization. To the returned student goes a large share of the credit for bringing to China under the Republic the conception of pure science as an independent body of knowledge possessing its unique methods of research and for causing to spring up in China research institutions from whose laboratories and field expeditions have issued in recent years results of value and interest to the scientific world.

41. The courses of study provided for in the first educational system outlined in 1903 are indications of the high regard for Western science then held by officials. In the lower and higher primary schools the study of the Classics and language was to occupy not quite half of the time while the balance was to be devoted to the study of ethics, Chinese history and geography,

nature study, mathematics and physical culture. In the middle schools somewhat less time was devoted to Chinese language and the Classics while among the other studies biology, physics and chemistry as well as mathematics were to be taught. In the newly established provincial and national universities departments of science were established for the study of mathematics, astronomy, physics, chemistry, zoology, botany and geology, while special colleges for the study of medicine, engineering and agricultural and industrial techniques were envisaged. This system was an almost exact replica of the one then in operation in Japan. The similarity of institutions in the two countries together with Japan's demonstrated success in the application of western sciences and techniques were fundamental factors in bringing this about.

42. Following the establishment of the first Ministry of Education in 1905, one of its initial acts was to secure the issuance of a decree fixing the educational aims. The purpose of the new system they said was to educate all and not a talented few, and the aims should be loyalty to the Throne, respect for CONFUCIUS, the awakening of the people to a sense of their national responsibility, the promotion of militarism and the development of reality and practicality in education. The memorialists pointed out that one of the most valuable results to be derived from education was to be able to put to practical use what had been learned. We note that in the West,—to paraphrase their comments,—three hundred years ago, the scholars lost themselves in vague theories and unrealities much the same as Chinese scholars do today. But since the time of BACON, an Englishman who developed the theory of experimentalism and demanded proof for all things, westerners have followed what he said. That is why western science and industry are so developed and so progressive at the present time. Thus in the new schools there should be more emphasis on facts and less on theory while scientific experimentation must be provided for in higher schools (37).

43. During this period an increasing number of western books on science was translated. In official circles special bureaus were established for the purpose. The demand for books on

(37) SHU, HSIN-CH'ÊNG, *Chin Tai Chung Kuo Chiao Yü Shih Liao* (2021, 10.547, 2875, 1352, 13659, 9893, 7070) ("A Collection of Documents on the History of Education in Modern Times,") (Shanghai, 1928), Vol. II, pp. 96-102.

western civilization had increased to such an extent that private publishing houses sprang up to meet it. Among such concerns were the Commercial Press and the Chung Hua Press now the two largest houses in China. They found a profitable business in translating and compiling books on western history, science and education and in the preparation of textbooks for students attending the new modern schools, the number of which had increased to over six million by 1911. Many of the works including those on science were translations from Japanese. Thus we find that one Japanese publishing firm in Shanghai listed 608 works in its catalogue for 1904-5 of which 97 were on education, 31 on physiology, 27 on political economy and 19 on arts and sciences (38).

44. The missionaries continued to publish scientific textbooks during this period. They had however lost the leadership of Chinese progressive thought, which they had held prior to the turn of the century, due to the fact that the Chinese now came into more direct contact with the West through the translation of western books, as well as through travel abroad (39).

Yet the sales of their works increased to meet the demands of their own growing school system. Thus during the years 1896 to 1899 the number of scientific works sold averaged from 200 to 600 a year, doubling the sale in years immediately preceding the war with Japan (40).

(38) HARADA, J., " Japanese Educational Influence in China," *Records of the Fifth Meeting of the Educational Association of China*, pp. 101-105.

(39) See LATOURETTE, *op. cit.*, p. 646.

(40) Among the textbooks on science published by Protestant Churches prior to 1911 were the following :

POTT, F. L. H. (Editor) *New Science Series* (*Ko Chih Chiu Chung*, 6029, 1832, 2263, 2886), 9 Vol. 1899.

MATEER, C. W., *Geometry* (*Hsing Hsüeh Pei Chih*, 4617, 4839, 8804, 1790) 1905.

ZIA, H. L. & PARKER, Dr., Loomis' *Trigonometry*, (*Pa Hsien Pei Chih*, 8504, 4532, 8804, 1790), 1909.

OWEN, S. (Rev.) & LI, CHIN-SHUAN, *Elements of Geology* (*Ti Hsüeh Chih Lüeh*, 10.956, 4839, 1791, 7564), 1899, 1909.

ZIA, H. L. (trans.) HENDERSON & WOODHULL's *Elements of Physics* (*Chih Hsüeh Hsin Pien*, 1892, 4839, 4574, 9178) 1904.

FERGUSON, J. C. & LI, SING-YUAN, *Chemistry* (*Hua Hsüeh Hsin Pien*, 5001, 4839, 4574, 9178) 1896, 1899.

NEAL, J. B. & SHANG, PAU-CHEN, *Analytical Chemistry* (*Hua Hsüeh Pan Chih*, 5001, 4839, 8610, 1892) 1897, 1908.

There follows below a statistical summary of the books on science published by the Protestant missionaries in China prior to 1918.

45. In this period Western thought and science commenced to alter and broaden the conceptions of modern Chinese intellectuals. LIANG CH'I-CH'AO and YEN FU are to be numbered among the few outstanding intellectual leaders who by their writings and translations brought about this transformation. HU SHIH, one of the foremost leaders of China and the " Father of the Chinese Renaissance " informs us that " through the popular writings of the late Mr. LIANG CH'I-CH'AO, the most powerful writer of his age, I came to know (in this first decade of the present century) a little of such western thinkers as HOBBES, DESCARTES, ROUSSEAU, BENTHAM, KANT and DARWIN " (41).

In his essays LIANG pointed out the admirable features of Western civilization and shocked innumerable Chinese out of their complaisant assumption that Chinese civilization was "... self-sufficient and had nothing to learn from the militant and materialistic West except in the weapons of war and vehicles of commerce " (42).

Science, in general	13	works
Arithmetic, all but one after 1910	11	»
Algebra, 1907-1917	4	»
Geometry, 1902-1912	8	»
Trigonometry, 1904-1911	2	»
Calculus, 1912	1	»
Astronomy, 1882-1914	18	»
Physics, 1884 and following	7	»
Hydraulics	1	»
Light	2	»
Heat, 1890, and 1899	2	»
Electricity, 1887 and following	3	»
Chemistry, 1871-1917	7	»
Biology, 1890	1	»
Zoology, 1893 ff.	8	»
Natural History, 1859 ff.	15	»
Geology, 1899 ff.	3	»
Agriculture, 1902 ff.	4	»
Medicine, 1900 ff.	13	»
Anatomy, 1850's ff.	7	»
Physiology, 1885 ff.	11	»
Hygiene and Sanitation, 1900 ff.	24	»
Pharmacy, 1890 ff. especially after 1900	8	»

Above information drawn from CLAYTON, G. A., *op. cit.*, passim.

(41) HU SHIH, In *Living Philosophies*, (New York 1931), p. 247.

(42) *Ibid.*

46. HU SHIH relates that he read YEN FU's translations of J. S. MILLS' *On Liberty* and HUXLEY's *Evolution and Ethics* (43).

The latter work was published in 1898 and was acclaimed by Chinese intellectuals. " Rich men gave money to have new editions made for wider distribution, because it was thought that the Darwinian hypothesis, especially in its social and political application, was a welcome stimulus to a nation suffering from age-long inertia and stagnation." (44)

The phrase : " survival of the fittest " found widespread journalistic expression. Even the " Shih " in his own name was adopted by Professor HU as it was the character meaning " Fittest " in the Chinese translation of the phrase. In 1907 HU became editor of a vernacular publication, one of many score of the time, called " The Struggle " which had for its purpose the popularization of modern ideas.

47. In the rush to meet the unprecedented demand for books dealing with science in this period it is not surprising that great confusion of terms arose. There was a marked influx of Japanese scientific terms which increased still more the confusion that had previously arisen. Despite this fact there was little attempt on the part of the Chinese to standardize scientific terms at this time. The missionaries made some progress, particularily the Committee on Terminology of the China Medical Missionary Association, established in 1890. By 1901 it had commenced publishing lists and had established sound principles for the determination of medical terms (45).

48. The outstanding developments that have transpired, in the course of the twenty and more years since the founding of the Republic have been the establishment of research institutions, and the application of scientific methods to the study of China's social, economic and historical problems. Accompanying these developments were the establishment of increased facilities for general instruction in the sciences as well as for advanced scientific training ; the more accurate translation of up-to-date

(43) For a list of YEN FU's principal translations see PEAKE, *op. cit.*, pp. 219, 220. For an interesting criticism of YEN's work see LAN, T'IAO-FU, *op. cit.*, p. 572.

(44) HU SHIH, *op. cit.*, p. *248.

(45) STUART, G. A , " Scientific Terminology " *Chinese Recorder*, (June, 1901), vol. 32, pp. 305-6.

scientific books; the compilation of more adequate textbooks and the standardization of suitable scientific terminology. Finally, we can note the effect in the writings of contemporary Chinese philosophers and litterateurs of the introduction of modern science upon their conceptions of the universe and its origin and evolution, as well as in their objective and critical attitude toward their own civilization—its history, its institutions, and its mores.

49. Since the founding of the Republic in 1912, the formal study of the Confucian canon has been eliminated (except for a brief revival) under YÜAN SHIH-K'AI-1913-1916) from the curricula of the national educational system. As in the West, the addition of scientific courses to the curricula has been made at the expense of the classics. The general curricula of the middle and higher schools of China require that all students devote one-fourth of their time to the study of science. Students electing to take special scientific courses provided in the senior middle schools, the normal schools and the colleges, must, however, devote a greater amount of time to science study. More technical and industrial schools have in addition been founded. According to the annual report of the Minister of Education in 1930, fifty different institutions of higher learning offered 750 courses of a scientific nature for 1.232 students, comprising 6.26 % of the enrollment. In addition, there were some 2.000 students in technical schools. Thus, in that year, one out of every six students pursuing courses beyond the middle schools planned for a career in either the pure or the applied sciences. The proportion of students going abroad that has enrolled, or is enrolling for scientific courses is higher than this, reaching the estimated figure of 50 % among the 1500 or more studying in the United States.

50. The quality of the scientific teaching and the adequacy of the textbooks and laboratory equipment still leave much to be desired. Professor GEORGE R. TWISS, following an extensive survey made in 1922, reports that : " With the exception of three or four middle schools and a few of the universities and colleges, the scientific equipment was found to be very inadequate..." while only a small percentage of the middle and normal school science teachers were well trained (46).

(46) In *China Mission Year Book*, (1924), pp. 283-287. Also consult TWISS, G. R., *Science and Education in China*, (Shanghai, 1925), *passim*.

51. Since that time efforts to improve this condition have been made. Special summer schools have been conducted for the purpose of giving science teachers additional training, while better textbooks have been translated or compiled. To these tasks the Science Society of China and the China Foundation, organized to administer the returned American Boxer Indemnity Funds, have given invaluable support. Despite these efforts the League of Nations Mission of Educational Experts in their report on education in China, which they drew up following an investigation made in the fall of 1931, stated in substance that science instruction in most schools still relies too much on textbook knowledge, often written in a foreign language and making use of non-Chinese materials. There is they emphasized not enough direct contact between the school and life. The students are not given an opportunity to apply to the physical and social world about them the methods and knowledge gained in the classroom. There is a notable lack of observation and experimentation on the part of the students themselves (47).

52. Science instruction has either fallen under the baneful influence of the book-memorizing tradition of old China or aims too exclusively at achieving utilitarian ends. The Educational commissioners felt that the Chinese " ... ought to learn that science is worth man's while not so much for the material power it gives him as for the attitude to which it accustoms the mind " (48).

They should derive from western science its true human value, its spirit and method if they would use it to fertilize their own culture and achieve "... the new synthesis of science, art and humanity..." that potentially they and perhaps they alone have it within their power to produce to the benefit of all mankind (49).

It will take time to fulfill these ideals and well it is that in this introductory period certain Chinese educational and intellectual leaders have caught this vision and are attempting to make it a reality through the educational system.

53. The creation of a standardized scientific terminology for the various sciences has begun to attain satisfactory solution only

(47) *The Reorganization of Education in China*, (Paris, 1932), p. 96.
(48) *Ibid.*, p. 39.
(49) *Ibid.*, p. 35.

within the past twenty years. In 1916, the Joint Committee on Scientific Terminology was organized under the auspices of the National Government, with members representing the Ministry of Education, the Chinese Medico-Pharmaceutical Association, the National Medical Association of China, the China Medical Missionary Association and the Science Society. The problems which confronted this committee were extraordinarily complicated by the use of Japanese scientific terminology, particularly by Chinese scientists trained in Japan, together with the use by missionaries and the Chinese scientists and educators of their respective terminologies. The Committee had not only to bring these three groups to accept a standard terminology, but also to create new terms either because they did not exist or because older terms were revealed to be inaccurate in the light of later knowledge (50).

54. As a result of the labors of the committee, most of the terms for the various sciences have now been standardized and formally confirmed by the Ministry of Education. Among the special scientific dictionaries or encyclopediae that already have been published are: the medical encyclopedia *Chung Kuo I Hsüeh Ta Tz'ŭ Tien*, (2875, 6609, 5380, 4839, 10.470, 12.402, 11.177) (1921) containing some 70.000 items; the dictionary of " Zoological Nomenclature " *Tung Wu Hsüeh Ta Tz'ŭ Tien*, (12.256, 12.777, 4839, 10.470, 12.402, 11.177) (1922), containing 12.000 terms; the dictionary of " Geological and Mineralogical terms," *Ti Chih K'uang Wu Hsüeh Ta Tz'ŭ Tien*, (10.956, 1892, 6588, 12.777, 4839, 10.470, 12.402, 11.177) (1930) containing 6.500 items; and the " Complete Dictionary of Botanical Terms," *Chih Wu Hsüeh Ta Tz'ŭ Tien*, (1849, 12.777, 4839, 10.470, 12.402, 11.177) (1918, 6th ed. 1926) containing some 6.000 items. Substantial progress, moreover, has been made toward fixing the terminology in the fields of mathematics, physics, chemistry, and biology. These compilations usually give the English or Latin equivalent immediately following the Chinese term, while their usefulness

(50) LAN, TIAO-FU, *op. cit.*, pp. 572-576. He gives good illustrations of the inadequacy of Japanese terms from the Chinese point of view, and reveals the necessity of a thorough knowledge of Chinese literature by those engaged in fixing scientific terminology. On the importance of a knowledge of the native literature also see above § 34 and note 33.

is further enhanced by the addition of indices in Japanese and Western languages. The frequent retention of Roman letters and Indo-Arabic numerals to express mathematical and scientific formulae has led to the frequent practise of printing Chinese scientific journals and books in Western style : that is, in horizontal lines running from left to right.

55. The number of scientific articles and books that have appeared is legion. For example, an index of articles on botany, biology, zoology, heredity, and eugenics, morphology and physiology published in 1925 contained over 900 articles which appeared in fifteen different scientific journals (51).

In the course of the last twenty years no fewer than thirty scientific and technical periodicals have appeared, published by nearly as many scientific societies and research institutions (52).

56. It will be possible here to recount briefly the organization and research work of only the three foremost scientific societies. The Science Society of China was founded in 1914, significantly enough at Cornell University in Ithaca, New York, by a group of Chinese students (53).

In 1918 its headquarters were moved to Shanghai. Its purpose as originally defined was... " to promote general scientific knowledge and increase people's interest in the technical industries in China... " Its monthly journal *Science*, the foremost of its kind in China, has appeared regularly since 1915. The Society now has over a thousand members, representing the physical, the biological, the engineering and the social sciences. It also publishes its annual *Transactions;* monographs written by the members of its biological laboratory and the departments of zoology and botany; popular treatises and a series of scientific textbooks. It is cooperating with the Fan Memorial Institute

(51) Compiled by LEI CH'I-JUNG in the *Tsing Hua Journal*, Vol. II, No. 2 (Jan.-Feb., 1925).

(52) From a list kindly prepared for the writer by the Reference Division of the National Library oi Peiping. Among the foremost scientific societies mentioned in this paper are the Astronomical Society of China, the China Mining Association, the China Society of Chemical Industry, the Chinese Engineering Society, the Chinese Geographical Society, the Chinese Physiological Society and the Institute of Mining and Metellurgy. Each of these societies publishes its own bulletin or journal.

(53) Information derived from pamphlet issued by the Society entitled *The Science Society of China*, (Shanghai, 1931).

of Biology (1928) in a project which has for its goal the systematic survey of the fauna and flora of the whole country. There have already been published systematic studies of Chinese ferns, flowering plants, fish and crustacea.

57. The department of zoology has grown from two persons to seven full-time research workers and three assistants. It has fairly good technical equipment and its specimens number 18.000 representing 1.300 species. Following a study of the fauna of Nanking it plans to extend its studies along the Yangtze river and down the coast. It also aims to make intensive studies of animal physiology, morphology and habits of life.

58. The botanical department was opened under the direction of Dr. H. H. HU in 1922. It is now concentrating its work on "... the classification and ecological observation of the flora... in Central and Southern China..." particularly in the provinces of Chekiang and Szechuan. Its museum has 10.000 classified and labelled samples representing 200 families, 1300 genera and 800 species. The personnel, comprising one professor, 4 research students and two assistants, had published by 1931 some thirteen papers.

59. Another outstanding scientific research institution is the Chinese Geological Survey organized in 1916. Modern geological studies in this vast and still not too well known terrain run back, however, to the latter half of the nineteenth century with the studies of PUMPELLY whose investigations were made in the sixties, to RICHTOFEN in the seventies, as well as to BAILEY WILLIS, ELIOT BLACKWELDER and R. H. SARGENT who conducted their field work in the early part of the present century (54).

60. Their studies were a stimulation to the Chinese and provided them with a measuring rod by which to check their own efforts. It was only under the Republic that they began to lay the foundations for studies in the geological field. At that time and since, as in other scientific fields they have had to rely upon the instruction and cooperation of western scientists. The first Professor of Geology in China was a German, Dr. SOLGER.

(54) See *Research in China* in 3 vols. and an Atlas published by the Carnegie Institution of Washington in 1907. For an extended bibliography of the studies, particularly in the descriptive sciences made by Westerners in China see CORDIER, H., *Bibliotheca Sinica*, 2nd Ed., 4 Vols. and Supplement (Paris 1923), *loc. cit.*

Dr. ANDERSSON and Dr. GRABAU, the latter formerly Professor of Paleontology at Columbia University, have long been associated with the Geological Survey, the foremost representative of this branch of science in China (55).

61. Two returned students H. T. CHANG and V. K. TING organized the first school of geology shortly after the establishment of the Republic. By 1916 there were twenty graduates from among whom was selected the nucleus for the staff of the Geological Survey organized in that year as a separate institution under the Ministry of the Interior (56).

62. Dr. V. K. TING became the first Director of the Geological Survey. The Survey has had a steady growth since despite financial difficulties and has at present a sizable working Library, a Museum, paleontological, fuel and soil laboratories and a seismological station. It has secured funds from the China Foundation, from mining companies as well as from wealthy Chinese. It has made extensive progress in preparing a complete set of geological maps of China. From its inception it has been interested in investigating the mineral resources of the country. It first made a thorough survey of some fifteen percent of the known iron ore reserves, results of which were published in the Memoirs of the Survey (57).

63. Its survey of coal reserves covers almost the entire country. Over thirty detailed reports with maps have been published in its Bulletin. From the latest estimates the total coal reserves of China are about 260 billion tons. The oil fields of Shensi, Kansu, Szechuan and Kueichou have been investigated; also the antimony, lead and tin of Yunnan and the tin of Kuangsi. It has published a series of statistical reports and general statements on Chinese mining industry.

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(55) *Bulletin of Geological Society of China*, "A. W. Grabau Anniversary Number," vol. 10, (1931).

(56) H. T. CHANG, "On the History of Geological Science in China," *Bulletin of the Geological Society of China*, vol. I, No. 1, pp. 4 et seq.

(57) TEGENGREN, F. R., "Iron ores and Iron Industry of China," *Memoirs of Geological Survey of China*, Series A, No. 2, (April, 1921). The author states that "... our knowledge regarding the geology and mineral wealth of China... is still very imperfect." (p. 1). He has summarized all earlier surveys and reports, many of which were made by foreigners. The work of earlier western investigators has undergone much revision. The estimate of RICHTOFEN and others as to the amount of China's mineral deposits appear now to have been exaggerated.

64. From the outset the Survey has emphasized the study of invertebrate fossils in view of their paleontological interest as well as for their stratigraphical significance for more precise knowledge of the Paleozoic and early Mesozoic formations. This work has gone forward under the competent guidance of Prof. A. W. GRABAU. A laboratory has been established for the study of Cenozoic fossils. Prof. GRABAU believes that some surprising results will come to science through a study of Chinese fossils as types found in the West have been found earlier in China and have survived longer (58).

65. To W. C. PEI of the Geological Survey goes much of the credit for the discovery of the *Sinanthropus Pekinensis* at Choukoutien some 75 kilometers southwest of the city in 1928-29. Anatomical studies by Père TEILHARD DE CHARDIN and C. C. YOUNG resulted in placing the hominid and associated fauna in the lower quaternary period, approximately contemporaneous with the Pithecanthropus of Java that is between 500,000 and 1.000.000 years ago (59).

66. The Survey has recently established a seismological station with Wiechert seismographs in the Western Hills near Peiping. A systematic study of over three thousand earthquakes recorded in Chinese historical records has been made. The latest enterprise of the Survey is a soil survey of China financed by the China Foundation with Dr. R. L. PENDLETON, an American, supervising the work (60).

67. The Academia Sinica has, since its inception by the National Government in May, 1927, under the temporary name, National Central Academy, been under the direction of the eminent educator Dr. TS'AI YÜAN-P'EI (61).

Its organization comprises nine research institutes including the Institutes of Physics, Chemistry, Engineering, Geology, Astronomy, Meteorology, Psychology, Social Sciences and History and Philology, each organized as an independent unit with head-

(58) GRABAU, A. W., " Paleontology " in *Symposium on Chinese Culture* (Shanghai 1931), pp. 176-191.

(59) WONG, W. H., " Geology " in *Symposium on Chinese Culture*, pp. 192-214.

(60) For a summary of the work of the Survey during its first fifteen years see *The National Geological Survey of China*, 1916-1931 (Peiping, 1931). Its publications comprise 24 volumes, 43 fascicles, 17 bulletins and 13 pamphlets.

(61) *The Academia Sinica and its National Research Institutes*, (Nanking 1931).

quarters in Nanking, Shanghai or Peiping. The Institutes have made rapid progress in launching and carrying out their respective research projects. The Institute of Meteorology is making hourly and daily records of climatic conditions at Nanking. The Institutes of Physics and Chemistry are making studies of the manufacture of chinaware, paper, paint, glass, as well as conducting researches on Chinese medicines. The Institute of Engineering is carrying on research at its laboratory in Shanghai. The Institute of Geology has sent out no fewer than ten geological survey expeditions. Extensive collections of Chinese flora and fauna are being made by the Metropolitan Museum of Natural History. The publications to date comprise some 150 articles, memoirs and monographs.

68. The China Foundation for the Promotion of Education and Culture has been of considerable aid in the rapid development of scientific research that has taken place in China in recent years. Founded in 1924 to administer the remission of further payments of the annual installments of the Boxer Indemnity due the United States it has resolved that these funds be "... devoted to the development of scientific knowledge and to the application of such knowledge to the conditions in China through the promotion of technical training, of social research, experimentation and demonstration and training in science teaching, and to the advancement of cultural enterprises of a permanent character, such as libraries and the like."

69. For the purpose of promoting the teaching of science the Foundation decided to establish thirty-five professorships in chemistry, physics, zoology, botany, psychology, etc. in the leading educational institutions of the country. It has also supported special summer training courses for middle school teachers of science. It has granted sums of money to the Fan Memorial Biological Institute, the Science Society, Geological Survey, and to the Academia Sinica. During 1930-31 twenty-five institutions received grants from the Foundation : 11 Universities and Colleges; 7 research institutes and 7 educational and cultural organizations in general. In the same period it granted 43 Scientific Research Fellowships. It has appointed a Committee on Editing and Translation under the chairmanship of Dr. Hu Shih which has for its purpose in part the translation of recent scientific works

and the edition of scientific textbooks. A number of texts for middle schools have already been published (62).

70. Biological studies have been the very last to develop.

Nevertheless, there are now twenty-three universities and colleges possessing biological departments, a few of which have zoological museums and herbaria. The value of such studies to agriculture and medicine is now widely recognized. The National South-eastern University, now the National Central University has been a leader in this field. The Metropolitan Museum of Natural History has been active in sending expeditions to Kuangsi, Szechuan and Kueichou, the results of which have been published in "Sinensia." The Biological Laboratory of the Science Society has been cooperating with the recently organized Fan Memorial Institute of Biology (1928) in commencing a systematic survey of the fauna and flora of the whole country. There has already been published systematic studies on Chinese ferns, flowering plants, fishes and crustacea (63).

71. A Marine Biological Laboratory was established in 1930 at the University of Amoy. It has become the foremost center for the study of marine flora and fauna in China. Amoy University has one of the largest herbaria in the country. The Botanical Institute of the College of Agriculture of the National Chung Shan University at Canton aims at a complete survey of the flora of Kuangtung province. Among the serial publications of these institutes and bureaus are : *Sinensia, Bulletin of the Fan Memorial Institute of Biology, Contributions from the Biological Laboratory of the Science Society of China, Sunyatsenia* and *Journal of Science* of the Tsing Hua University.

72. The progress being made in zoological studies is gradual. The Biology Department of Yenching University is studying the aquatic insects of Eastern China. The Fan Memorial Institute has been devoting a portion of its energies to the publication of a book descriptive of the birds of China, and the crabs of North China. The country, embracing as it does three climatic zones exhibits great variation of topography and the richest flora and

(62) See the sixth annual report of the China Foundation for the Promotion of Education and Culture (1931).

(63) PING, C., and HU, H. H., " Biological Science " in *Symposium on Chinese Culture*, pp. 227-240.

possibly fauna of all temperate regions with endemicism highly developed (64).

This accounts for the unparalleled richness of the Chinese pharmacopaeia. Certain notable additions to the storehouse of Western drugs as corydalis, ephedrine, sinomerium as well as chaulmoogra oil, the only known remedy effective in aiding the cure of leprosy have been recognized as contributions (65).

73. The introduction of the modern medical sciences into China began with the Jesuits in the seventeenth century. Father TERRENTIUS compiled a book on human anatomy in Chinese, while Father PARRENIN translated " L'Anatomie de l'homme suivant la circulation du sang, et des nouvelles découvertes par DIONIS " (66).

The Jesuits gained favor at Court in part because of their healing powers. The Emperor K'ANG HSI was cured of a malignant fever by one of their number in 1692.

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(64) WILSON, ERNEST H., *China Mother of Gardens*, (Boston, 1929). This authority writes that, " Competent authorities estimate the Chinese flora to contain fully 15.000 species, half of which are peculiar to the country... (and it is) the richest flora in the world." (p. 278). " Our Tea, Polyantha and Rambler Roses, Chrysanthemums, Indian Azaleas, Camellias, Greenhouse Primroses, Mountain Peonies, and large flowered Clematis have all been derived from plants still to be found in a wild state in central and western China. The same is true of a score of other favorite flowers. China is also the original home of the Orange, Lemon, Citron, Peach and Apricot." Indeed there are few gardens in the north temperate zone that do not contain at least a few Chinese plants. (p. 279).

(65) For information on the *Pên Tsao Kang Mu* (8846, 11.634, 5900, 8080), the Chinese Materia Medica, and its contributions to modern medicine, consult WONG, K. C. and WU, L. T., *History of Chinese Medicine* (Tientsin, 1932) which contains an extensive bibliography. The writings of Dr. B. E. READ on Chinese drugs are especially noteworthy contributions to the subject. In particular see his *Chinese Materia Medica*, (Peiping, 1931). Also see BRETSCHNEIDER, EMIL, " Botanicon Sinicum : Notes on Chinese Botany from native and Western sources." *Journal North China Branch Royal Asiatic Society*, vol. 16 (1881), pp. 18-230; vol. 25 (1890-91), pp. 1-468; vol. 29 (1894), 623 pp.

(66) WONG, K. C. and WU, L. T., *op. cit.*, pp. 133, 134. The most authoritative work in Western languages on native Chinese medicine is Fr. HÜBOTTER's *Die Chinesische Medizin zu Beginn des XX. Jahrhunderts und ihr Historischer Entwicklungsgang*, (Leipzig, 1929; see *Isis*, 14, 255-63). There has just been announced a series of four volumes on Chinese acupuncture by G. SOULIÉ DE MORANT. The first of these, which is now in press is a translation by him and Dr. SAKURAZAWA of Dr. NAKAYAMA's " L'Acupuncture et la médicine Chinoise vérifiée au Japon." The remaining three volumes will be devoted to Chinese acupuncture itself. The publisher is PAUL GEUTHNER, Paris.

74. However, with the decline of missionary activity in the eighteenth century western medical influence came to an end. It was reintroduced early in the nineteenth century. In 1803 Dr. PEARSON of the East India Company introduced Jenner's vaccine. The major credit for the promotion of western medical practise from that time until the beginning of the present century goes to the Christian missionaries, particularily the Protestants. Throughout the nineteenth century they continued to open in practically all parts of the country clinics, dispensaries and hospitals, to translate books, and to formulate medical terminology (67).

75. A great step forward in raising the standards of medical instruction was taken in 1916 when the China Medical Board of the Rockefeller Foundation took over the Union Medical College of Peking as a result of which that institution has taken the lead in medical education in China. As far as standards and equipment are concerned it is scarcely without its peer in the world. Moreover the Foundation has granted financial aid to more than a score of hospitals and medical schools in China, and has assisted in endowing departments of biology, chemistry and physics in missionary and Chinese colleges. In the year 1929 alone it expended $272.801 for the promotion of education in the natural sciences.

76. China is still far from being adequately supplied with well trained modern physicians, or suitably equipped hospitals. According to a report made by Dr. FABER, who made a survey of medical education on behalf of the League of Nations in the fall of 1930, there are only 4-5.000 modern trained physicians, or one for 80-100.000 people. At present there are only a dozen medical schools giving satisfactory training and they graduate only 180 Doctors a year.

Despite the obstacles to be overcome progress in the development of medical science has been steadily going forward in the face of discouraging political and financial handicaps.

77. The application of modern science to China's agricultural problems is only beginning (68). There are now twelve agricul-

(67) For an account of this development see WONG, K. C. & WU, L. T., *op. cit.*, and LATOURETTE, K. S., *op. cit.*, passim.

(68) FENG, R., "Agriculture," in *Symposium on Chinese Culture*, pp. 261-277; TAWNEY, R. H., *Land and Labour in China* (London, 1932), passim.

tural colleges in China of which three are national, six are provincial, one is private, and two are American missionary institutions. National and provincial colleges have been hindered by lack of funds and political turmoil. The Ministry of Agriculture has eleven experimental stations under its direction. One is a general station, four are Cotton investigating stations; one Tea, three Farm Animal, and two Forestry, respectively. The results to date are meager as this branch of applied science is still in an introductory stage through which all the branches have passed when first taken over from the West before the problems of the China field had become realistically grasped and the necessary adjustments made.

78. The outstanding College where effective work is now being done is connected with Nanking University, a missionary institution. Research there is under the direction of J. LOSSING BUCK who has gathered about him capable Chinese co-workers. The work in seed selection is especially noteworthy as are the surveys of agricultural conditions, the most extensive one of which was published by Dr. BUCK under the title, "*Chinese Farm Economy*," in 1930.

79. The incorporation of the social sciences, particularly economics, statistics and sociology into the curricula of the schools, and the application of the methods employed in these fields to the study of China's social and political problems has lagged for more than a generation behind the introduction of the physical sciences. Indeed it was only to come about after the Republic had been established a number of years. By that time the efforts of reformers to solve China's pressing problems through political reform and militarization along modern lines had clearly demonstrated their inadequacy. Discouraged by it all, intellectual leaders came to the realization that fundamental reform lay in modernizing the economic and social structure of their society and to accomplish this they felt that they must bring to a greater number of their people, through the easier medium of the vernacular language, some concept of western science and the methods by which to apply it to the solution of their own peculiar problems.

80. The use of statistical methods for ascertaining more accurately China's prevailing economic and social status as a prelude to the formulation of programs designed to improve

rural and urban conditions, has only recently come into vogue. The National government, which established its capital at Nanking in 1928, has set up a statistical bureau which cooperates with the various departments in gathering statistics with respect to population growth, wage scales, family budgets of peasants, industrial workers, etc. Some of the more significant results have been published in the official *Statistical Monthly*, the first number of which appeared in March, 1929.

81. In addition to the research work of the National government are the surveys made by the social affairs bureaus of the larger municipalities. The foremost of these bureaus is the one at Shanghai which has been publishing in its monthly journal, the *Shê Hui Yüeh K'an* (9803, 5184, 13.768, 5862), the first number of which appeared in January 1929, statistical studies on labor strikes, wage scales, price fluctuations, etc. in that city. Moreover, the government-supported Academia Sinica through its Institute of Social Sciences has been conducting researches on agrarian problems. It has already published the results of investigations made into the agrarian systems at a number of places including Wusih and Paoting. It has also collected ethnological data on certain tribal folk in the Far East, such as the Tungus in Manchuria and the Lolos in Szechuan.

82. Among the foremost private institutes for social and economic research are the Nankai University Committee on Social and Economic Research, of which the American-trained economist Dr. FRANKLIN L. HO is Chairman; the Institute of Social Research of the China Foundation, supervised by Dr. L. K. TAO, which publishes a *Quarterly Review of Social Science;* the research department of the National Association of the Mass Education Movement, which has made a comprehensive social and economic survey of life in one of the villages of Ting Hsien; and the Agricultural Department of the Nanking University, headed by J. L. BUCK. Among the publications made by Dr. HO's Committee at Tientsin are accounts of conditions among factory workers in North China and the extent and effect of industrialization in China. The results of the survey made by the Mass Education Movement will be published in English by SIDNEY D. GAMBLE, who has been closely associated with the work in Ting Hsien since its inception. The Institute of Social Research

has published: "An Introduction to the Methods of Social Survey"; "Livelihood in Peking"; "Factory Workers at Tang-ku"; and a "Chinese Labor Yearbook." An especially interesting project, on which the Institute is at work, is a study of social and economic conditions under the Ch'ing dynasty, abundant material for which is to be found in the recently opened archives of that dynasty in Peiping (69).

The amount of material is evidenced by the engagement of as many as fifty copyists at one time to transcribe the documents on this subject.

83. The formal teaching of sociology in the colleges and universities has lagged lamentably according to Professor LEONARD Hsü of the department of sociology and social work of the Yenching University (70).

In 1927 with but one exception none of the government institutions of higher learning had a separate department of sociology (71).

The Christian institutions are far in advance—particularly the Yenching (72), Nanking and Shantung Christian Universities. However, there was a serious dearth of literature in the Chinese language for the conduct of such courses in 1925. Hsü deplores the lack of textbooks in sociology especially prepared for Chinese students, and containing material illustrative of Chinese life (73).

84. As has already been observed the foundations for the production of original and effective research have been laid more firmly in the physical and natural sciences than in the social sciences. In historical studies, however, the Chinese have antedated Western historians in the use of the inductive method, and in the gathering of evidence in order to criticize ancient texts. In fact by the middle of the seventeenth century Confucian scholars of the school known as the *Han Hsüeh P'ai* (3836, 4839,

(69) PEAKE, C. H., "Documents Available for Research on the Modern History of China," *American Historical Review*, vol. XXXVIII, No. 1 (Oct. 1932), pp. 61-70.

(70) See "The Teaching of Sociology in China," *Chinese Social and Political Science Review* (July, 1927) vol. XI, no. 3, pp. 373 et seq.

(71) The sociology department of the National University of Peking is the exception. It commenced in October, 1922 the publication of a *Social Science Quarterly*.

(72) The sociology department of Yenching started publication of the *Yenching Social Science Quarterly* in April, 1930.

(73) "Chinese Sources in General Sociology," (C. S. P. S. R.) Vol. II, No. 1 (January 1927), pp. 14 et seq.

8583) in their efforts to emancipate Confucianism from the subjectivism and rationalism of CHU HSI and his school in the Sung dynasty, (who had been unduly influenced by Buddhist and Taoist metaphysics) " ... had developed a genuinely scientific method of study and investigation. Every philological reconstruction of textual criticism had to be based on evidences. With the aid of this new methodology the scholarship of the last three hundred years became quite scientific and a number of historical sciences, notably philology, textual criticism and archeology reached a high stage of development " (74).

85. The movement to reconstruct China's past which began then was given renewed impetus by K'ANG YU-WEI, who at the close of the nineteenth century in his efforts to make reform popular in China went back of the Han dynasty (206 B.C.—221 A.D.) forgeries to what he called the " authentic " texts of CONFUCIUS himself and attempted in his book, " Confucius as a Reformer," *K'ung Tzu Kai Chih K'ao* (6605, 12.317, 5783, 1910, 5966) (1897) to picture the Master as playing the rôle of an innovator rather than being " ... a mere historian and conservator and of ancient values " (75).

In his book " Forged Classics of the Wang Mang Period," *Hsin Hsüeh Wei Ching K'ao* (4574, 4839, 12.522, 2122, 5966) (1891) an attempt is made to prove that many of the Classics were forgeries of that period (9-23 A.D.). Later scholars more under the influence of Western critical methods of research than K'ANG, asserted he did not go far enough in his criticism of the Classical and historical literature, remaining, as he did, to the end of his life, an ardent Confucianist.

86. Out of the contact with Western civilization and the introduction of Western methods of historical research including archeology and comparative studies in folklore came the *Chêng Li Kuo Ku* (697, 6879, 6609, 6190) movement for the reorganization of China's cultural heritage (76).

(74) HU SHIH, " The Civilizations of the East and the West " in *Whither Mankind*, p. 32; HUMMEL, ARTHUR, W. *The Autobiography of a Chinese Historian* (Sinica Leidensia, Vol. I, Leyden, 1931), pp. V-XLII. For possible Jesuit influence on this movement see above Note 5.

(75) HUMMEL, *op. cit.*, pp. XI-XIII.

(76) For a statement of the aims and methods of this group and of those associated with this movement see HUMMEL, *op. cit.*, pp. XXX-XXXVI.

Speaking of Western influence on this movement KU CHIEH-KANG, one of its outstanding leaders has written that

> ... the introduction of new sciences from the West exerted a powerful influence upon Chinese scholars, awakening them to the necessity of a radical change in their methods of study, involving a re-systematization of all our ancient knowledge, in order to increase its intelligibility and ascertain its historical value. The first outcry for the 'reorganization of the national past' (*Chêng Li Kuo Ku*, 697, 6879, 6609, 6190) began with the writings of CHANG T'AI-YEN, but the problem was not systematically attacked until HU SHIH propounded his concrete program... When Dr. HU SHIH returned from the West, he brought with him western historical methods by which he was able to illustrate, by the use of novels and folklore, the evolutionary changes in our ancient social system " (77).

87. Contact with the West not only gave Chinese scholars new methods of research but also supplied them with a new and a broader point of view from which to study their own past. They were able to escape a thought-world bounded by Confucianism, and to view with less prejudiced eyes other schools of thought in China that once unsuccessfully, though not without leaving certain traces of their influence on the Confucian system, competed with the Confucianists for the allegiance of the people and the State. With respect to these, HU SHIH has written, that, "For my part, I believe that the revival of the non-Confucian schools is absolutely necessary because it is in these schools that we may hope to find congenial soil in which to transplant the best products of Occidental philosophy and science " (78).

88. The introduction of western archeological methods into China by foreigners and the use made thereof either by foreign or Chinese or joint Sino-foreign expeditions, has resulted in a more authentic and satisfactory portrayal of the origin and development of Chinese civilization than has been traditionally set forth in Chinese Classical and historical literature. In the course of certain surveys conducted by the Geological Survey under the supervision of the Swedish member of the staff, Dr. J. C. ANDERSSON, very interesting and illuminating neolithic sites were chanced upon

(77) HUMMEL, *op. cit.*, pp. 150, 152.

(78) HU SHIH, *The Development of the Logical Method in China*, (Shanghai, 1922), p. 8.

in Manchuria, Kansu and Honan. These discoveries together with the work of European archeologists, such as PELLIOT and STEIN and Fathers CHARDIN and LICENT, as well as the location of the site of the Honan divination bones of the 2nd millenium B.C. stimulated the Chinese to undertake extensive archeological studies. For centuries since the Sung dynasty Chinese scholars have conducted archeological studies of the limited antiquarian type. During the last one hundred and fifty years of the Manchu dynasty the interest in these studies was extensive, as many as four hundred valuable works having appeared (79).

89. However, the Chinese have failed until very recent years to study materials *in situ* and to derive therefrom their full significance as revealing the origins and development of Chinese civilization. The Institute of History and Philology of the Academia Sinica has now taken up this work. Its first important diggings have been at Anyang. The Freer Art Gallery of the Smithsonian Institution has cooperated in this work in its early stages through its field representative Carl Bishop (80).

Another scientific expedition of much promise is that led by the famous Swedish explorer SVEN HEDIN. It began its work in Inner Mongolia and Chinese Turkestan in 1927-28. To its staff was appointed ten Chinese students and scholars who have

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(79) LIANG CH'I-CH'AO, " Archeology in China" *Peking Leader Reprint* No. 25 Peking, 1926; WANG KUO-WEI, " Archeology in the Sung Dynasty," *China Journal of Arts and Sciences*, Vol. VI, No. 5, pp. 222-231. The Jesuit Fathers LICENT and TEILHARD DE CHARDIN were the first to discover in 1923 evidences of the existence of paleolithic man in China. They have contributed greatly to the futherance of the study of pre-historic man, particularly CHARDIN who has long been closely associated with the Geological Survey. See CHARDIN and LICENT, " The discovery of a paleolithic industry in North China." *Bulletin of the Geological Society of China*, Vol. 3, No. 1 (1924), pp. 45-50; LICENT, CHARDIN and BLACK; " On a presumably pleistocene human tooth from the Sjara-ossogol deposits," *Bulletin of the Geological Society of China*, Vol. 5, Nos 3-4 (1927), pp. 285-290; ANDERSSON, J. G., " Early Man " *Memoirs of the Geological Survey of China*, Series A, No. 3, pp. 131 et seq.; SMITH, ELLIOT G., " The Discovery of Primitive Man in China," *Antiquity*, March, 1931, pp. 21-26 and NELSON, N. C., " Archeological Research in North China," *American Anthropologist*, Vol. 29, No. 2 (April-June, 1927), pp. 177-200. Also see the reports of the Central Asiatic Expeditions of the American Museum of Natural History.

(80) LI CHI, " Archeology," In *Symposium on Chinese Culture*, pp. 215-226. The Anyang reports of the Academia Sinica have been recently awarded the Julean prize by the Academie des Inscriptions et Belles-lettres,

assisted in the meteorological, geological and archeological work of the expedition (81).

90. The Literary Revolution which arose in 1917 had for its purpose the freeing of Chinese thought from the restraining shackles which expression in the Classical or Wen Li language imposed. The necessity of finding a freer medium of expression in the vernacular, or the Pai-hua made itself more and more apparent as the Chinese moved further into the intellectual, political and social currents of the modern world. Students in the modern schools no longer had the time to memorize the Classics as of yore nor learn to write in a cryptic and archaic style long since divorced from the nation's living speech. Moreover, the urgent desire on the part of the leaders to reach an ever increasing number among the masses in order to win their support in the effort to solve social and political problems that pressed on every hand led to the widespread use of the vernacular. The times were ripe for this change and within a few years the greater number of new books and magazines which appeared were written in the vernacular while the government ordered that it be taught in primary schools. The intellectual ferment was deepened and intensified. An analysis made of the innumerable articles in the four hundred magazines that quickly sprang up reveals that ten per cent were of a scientific character; forty percent were purely literary, while fifty percent were devoted to general discussions of an ethical, philosophical and political character (82).

91. The Youth Movement which arose in 1919, likewise bears evidence of the influence of modern science particularly as it gave support to anti-religious movements. Science and religion were held to be irreconcilably antagonistic. CH'ÊN TU-HSIU, one of the leaders of the movement, writing in the *Youth Magazine* advised the students among other things to be " ... scientific and not idealistic... Idealism is proper to the infant stage of peoples. All religions were produced by idealism. That which makes the people of Europe actually superior to all nations is

(81) SVEN HEDIN, *Across the Gobi Desert*, (New York, 1932), p. 41.

(82) DE VARGAS, P. H., " Some Elements in the Chinese Renaissance," *New China Review*, vol. IV, 1922, p. 243. In this connection also consult DUYVENDAK, J. J. L., " A Literary Renaissance in China," *Acta Orientalia*, Vol. I, 1923.

their positive science, their reason. Science and reason have made an end to ignorance and superstition." Science, he pointed out hasn't explored all phenomena as yet, but its practical applications are already numerous and these the young of China should embrace as a means whereby to preserve and strengthen the nation (83).

The anti-religious movement of 1922-24 was highly colored by the general conception of the antagonism between science and religion.

92. The philosophies born of the rise of modern science and the industrial revolution have secured widespread acceptance among the intelligentsia. Representative works of such outstanding philosophers and scientists as DESCARTES, HUME, ROUSSEAU, DARWIN, NIETZSCHE, SPENCER, HUXLEY, SCHOPENHAUER, EINSTEIN, RUSSELL, JAMES and DEWEY have been translated into Chinese.

93. The traditional skepticism of Confucianism with regard to the " spirits " and its emphasis on the " here and now " relationships of men *in* society made easy the ready acceptance of the pragmatic and naturalistic tendencies of contemporary western thought. The struggle of the Ch'ing scholars to emancipate Confucianism from the metaphysical interpretations of the Sung philosophers achieved an unforeseen success through contact with western thought that resulted in the rejection of Confucianism itself as an adequate philosophy with which to meet the problems of this age. The temper of modern thought in China is seen in the welcome accorded the lectures of Professors DEWEY and RUSSELL in China and the less enthusiastic reception given in some quarters the visit of RABINDRANATH TAGORE.

94. The pragmatic tendency in Chinese thought is best represented by HU SHIH, a former student of JOHN DEWEY. He once wrote, " We have studied and observed the need of our time; we cannot help but conclude that the greatest of all is the application of scientific methods to the problems of life " (84).

The naturalistic tendency is represented by TING TSAI-CHUN, an opponent of metaphysics, who calls his theory of knowledge " skeptical idealism " (85).

HSIAO TZŬ-SHÊNG finds the moral law and the natural law

(83) Père LÉON WEGER, *Le Flot Montant*, p. 9 et seq.

identical, and is thus in part a Confucianist. The realistic tendency in literature is represented by CH'ÊN TU-HSIU and LU HSÜN (Chou Shu-jên) (86).

Such Confucian influence as remains is seen in the humanistic tendencies of most Chinese thinkers.

95. The profound influence of scientific thinking on leading scholars is seen in the publication in 1923 of a series of discussions on the relations of science to life and conceptions thereof by such men as LIANG CH'I-CH'AO, V. K. TING and CHANG CHÜN-MAI (87).

The discussion was started by V. K. TING's article "Science and our Philosophy of Life." HU SHIH wrote an introduction to the work summing up the discussions, and closing with his credo (88).

This credo draws its inspiration from the verifiable results of scientific research in all fields. He holds that space is infinitely large (the concept of finite space and an expanding universe had not then wide acceptance) extends over infinite time, that there is no need of the concept of a Creator, nor benevolent Ruler; that man differs in degree and not in kind from the animal world; he believes in the evolution of organisms and of society; that all psychological phenomena are explainable by the law of causality; that morality and religion, are subject to change; that matter is full of motion and not static. He believes in the immortality of the "Larger Self" and "... that to live for the sake of the species and posterity..." is the religion of the highest order; all other religions being selfish. "This new credo is a hypothesis founded on the generally accepted scientific knowledge of the last two or three hundred years... I propose to call it... the Naturalistic Conception of Life and the Universe" (89).

This conception he asserts is "... not necessarily devoid of

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(84) *Collected Essays*, vol. III, p. 270, quoted by Y. S. HAN, "Some Tendencies of Contemporary Chinese Philosophy," *Journal of Philosophy*, vol. 25, no. 19, (1928), p. 509.

(85) *Ibid.*, p. 509.

(86) *Ibid.*, pp. 509-513.

(87) "An Examination of Science and the Life of Man," (*K'ê Hsüeh Yü Jên Shêng Kuan*, 6089, 4839, 13.522, 5624, 9865, 6363), 2 vols., (3rd ed. 1925).

(88) HU SHIH in *Living Philosophies*, pp. 260, 261.

(89) *Ibid.*, p. 262.

beauty, of poetry, of moral responsibility, and of the fullest opportunity for the exercise of the creative intelligence of man " (90).

96. Finally, by way of conclusion, it may be observed that the introductory stage in the history of modern science in China is now drawing to a close. Modern educated Chinese have fostered the introduction of the applied sciences as the only effective means of securing for their nation that position of equality and influence in the world which its material resources and its people entitle it to assume. Moreover, a few of these intellectual leaders have caught a vision of the rewards and possibilities of research in the pure sciences and have established a number of research institutes. Within recent years Chinese scientists have taken their places at important international scientific congresses. One no longer hears, as frequently as in the past, the blunt assertion that the Chinese, because of certain racial and social characteristics are incapable of becoming accurate and objective scientists. Nor do doubts concerning the possibility of expressing in the Chinese language scientific terminology make themselves so conspicuous as formerly. Furthermore, many of the Chinese given to philosophical speculations have found in modern science a more satisfying interpretation of the Universe and of man's place therein than in the older world-conception of Confucianism, or in the metaphysics of Buddhism and Taoism.

97. To be sure modern science has not yet attained that independent status which it holds in certain Western countries, nor in Japan. The promotion of scientific training and research is still dependent to a degree, not only upon the guidance and stimulation of foreign scientists in China, but also upon foreign financial assistance extended indirectly through returned Boxer Indemnity funds, or through the China Medical Board Inc. and Mission Boards (91).

Moreover, the quality of science instruction, in the developing,

(90) *Ibid.*, p. 263.

(91) While the Catholic and Protestant missionaries have lost the leadership in scientific research and instruction to the Chinese themselves, nevertheless, they have continued to contribute to the development of science in China. The scientific instruction in their schools and Universities is on a par with that available in the best Chinese institutions. For a fuller treatment of their contribution in the earlier periods see above § 1-44.

though still far from adequate educational system, calls for marked improvement which will take much time, money and effort, to bring about. Nevertheless, sufficient independent researches have been conducted by the Chinese themselves in their own established institutes and departments of science with results of increasingly higher quality, to give foundation to the assuring belief that the modern sciences have taken root in Chinese soil.

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Notes and Correspondence

I. — QUERIES AND ANSWERS

The Rule of Three in Arabic and Hebrew Sources.—Answer to Query no. 23 in *Isis*, 20, 1933, p. 260-62.

1. The Arabic books or chapters of books dealing with the Rule of Three are called *Mu'āmalāt*, which means " Business Transactions." This is still reflected in some of the mediaeval European treatises on the Rule of Three which are named *Regula Mercatorum*, " Merchants' Rule," or " Merchants' Key." (1) Hence SARTON correctly translated the title of the treatises on *Mu'āmalāt* with " Commercial Arithmetic."

2. None of the manuscripts mentioned by Dr. SARTON in his query are accessible to me, but I have a much older source, and this is the *Algebra* of AL-KHUWĀRIZMĪ (c. 820), one chapter of which, called *Bāb al-Mu'āmalāt*, Chapter on Mercantile Transactions, is to be found on pp. 48-50 of the Arabic text and on pp. 68-70 of the English translation. (2) This is the oldest Arabic source on the Rule of Three, or as the Arabs call it, on Business Transactions. This chapter and a few of its parallels in the later Arabic and in the earlier Hindu sources are thoroughly discussed by J. RUSKA, *Zur aeltesten arabischen Algebra*, Heidelberg, 1917, pp. 92-102. In addition to that I also refer to AL-KARKHĪ (d.c. 1020), *Kāfī fī-l-Ḥisāb* (3), II, pp. 16-18; AL-BĪRŪNĪ (c. 1000), as quoted by SMITH, *History of Mathematics*, II, 489, note 2; and AL-QALASĀDĪ (c. 1475), as quoted by CANTOR, *Geschichte der Mathematik*, I, 3rd ed., p. 815.

3. The Arabic text at the beginning of AL-KHUWĀRIZMĪ's chapter on the Business Transactions, on p. 48, is corrupt. This was already recognized by RUSKA, and the corrupt words were correctly emendated by him on pp. 96-97 of his above quoted book. RUSKA's emendations on p. 97, notes 1 and 2, are verified by the Arabic manuscript of the *Algebra*,

(1) See D. E. SMITH, *History of Mathematics*, II, 488.

(2) Ed. F. ROSEN, London 1831.

(3) Unfortunately AL-KARKHĪ's book is available only in a German translation by HOCHHEIM, Magdeburg, 1878-80.

of which I have a photographic copy, while the corrupt reading *al-thaman wal-muthamman* is also in the manuscript. ROSEN's English translation of the terms *si'r* and *thaman* is better than the German suggestion by RUSKA (p. 98). *Si'r* is not " die Schaetzung," but just the opposite of it, i.e. " the general, fixed market price." *Thaman* is " the individual price," arrived at through bargaining and compromise, or through estimation and calculation of the ratio (4). The meaning of these two terms is clearly established through the inner evidence of the context here, through the definitions given by AL-KARKHĪ (*loc. cit.*, p. 16) and SAVASORDA (5), and through the corresponding Hebrew Aramaic terms *sha'ar*, *shum*, *shammēn*; see the Talmudic dictionaries of LEVY and JASTROW to these words. In the etymology of *shammēn* JASTROW is mistaken and LEVY is right.

4. ABRAHAM SAVASORDA (d. in or after 1136) has in his so-called Encyclopaedia, *Yesodē ha Tebunah*, a chapter on the Rule of Three. The Hebrew inscription of this chapter is *Ḥeshbonē ha-Mikkaḥ weha-Mimkar*, " Calculations of Purchase and Sale," which is the verbal rendering of the Arabic *Mu'āmalāt*. This Encyclopaedia is not " almost completely lost," as SARTON (6) thinks, but almost completely preserved. The name Encyclopaedia, commonly accepted with regard to the contents. is misleading with regard to size. It is a comparatively short treatise dealing with arithmetics, geometry including optics, and music. Only these three subjects and parts are mentioned in the introduction. Astronomy, supposed to be contained in it, is not mentioned in the introduction, nor did I find it in the text. The two parts, arithmetics and geometry, and the introduction are completely preserved in the famous Cod. Hebrew 36 of the Munich Library, ff. 103*b*-109*a*, in twelve large folio pages written in a small Hebrew script. The missing third part, on music, may have comprised, at the utmost, 5 or 6 pages. I have a photograph copy of the extant twelve pages, which I also compared with the original, while in Munich in the Summer of 1930. The chapter on the Rule of Three is there on f. 206*a*-206*b*, at the end of the first part, dealing with arithmetics, and followed by the geometry. It is interesting to note that the same place is assigned to the chapter on the Rule of Three in the books of AL-KHUWĀRIZMĪ and of AL-KARKHĪ. It is at the end of the algebra, respectively arithmetics, and followed by the geometry.

SAVASORDA renders the term *si'r* with *sha'ar*, *thaman* with *damīm*, *musa'ar* with *seḥōrah*, and *muthamman* with *nimkar* or *mekher*. RUSKA

(4) From the Latin verb *reri*, " to think, estimate."

(5) See hereafter.

(6) *Introduction*, II, 207.

(p. 98) did not understand the term *mubā'in*. It means " separated, cut off from intercourse, strange, having no relation, no ratio." It exactly corresponds to the Hebrew term *nokhrī*, " a stranger," used by SAVASORDA. ROSEN's translation : " inversely proportionate " is, philologically and historically, wrong, as AL-KHUWĀRIZMĪ had no idea of the inversely proportionate. The two numbers having a ratio are called by SAVASORDA *ḥaberīm*, " companions, friends." In Arabic this would be *aṣḥāb*. Hence in the proportion $a : b = c : d$, a and d, b and c are " strangers " ; a and b, c and d are " companions."

The Rule of Three is also discussed by IBN EZRA (d. 1167) in his *Sefer ha Mispar*, chapter VI, pp. 46-60.

5. The Rule of Three was known to the Hindus as early as the fifth century A.D. Its origin, however, goes back to the ancient Egyptians and Babylonians. The Egyptians used the method of the Rule of Three for the solution of a linear equation already in the time of the Rhind Mathematical Papyrus (7). There is no necessity to assume that the Arabs learned the Rule of Three from the Hindus. The Arabic terms *si'r* and *thaman* are Aramaic loanwords. The probability is that the Hindus and Persians have learned the " commercial arithmetic " from the Aramaean merchants through the medium of the Natabaeans or other pre-Islamic Arabs, who for centuries were the carriers and intermediaries of the commercial traffic between India, Persia, Egypt and Western Asia.

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Hippocratic oath in Arabic.—Answers to Query no. 24 (*Isis*, 20, 262). Refer also to the oath in the book of ASAPH as described in VENETIANER's volume, p. 12-14 (see SARTON's *Introduction*, 1, 614).

(*Baltimore*). HARRY FRIEDENWALD.

In an article of the *Rotary Bulletin* of Cairo, Feb. 1933, MAX MEYERHOF remarks " The Hippocratic oath made from the beginning of Islam a profound impression on the Arabic-speaking doctors, Moslems, Christians or Jews " ; he exemplifies the high ethical standards of ḤUNAIN BIN ISḤĀQ and 'ALĪ BIN 'ABBĀS and finally quotes the medical will of MUḤAMMAD AL-GHĀFIQĪ which he has recently found in an ophthalmological treatise of the latter. This MUḤAMMAD AL-GHĀFIQĪ should not be confused (as I did in my *Introduction*, 2, 424) with AḤMAD IBN

(7) Cf. PEET, p. 61; SMITH, *History*, II, 436; on the theory of proportions with the Egyptians see STRUVE, the *Moscow M. P.*, pp. 44-98; ARCHIBALD's review of it in *Isis*, 16, 1931, p. 150-52; *Idem, Bibliography of Egyptian Mathematics*, subject-index, v. Pyramids-seked; NEUGEBAUER, in *Quellen und Studien zur Geschichte der Mathematik*, B.I, 4, 8; GANDZ in *Isis* 12, 1929, p. 459 f.

MUḤAMMAD AL-GHĀFIQĪ, Spanish physician and botanist who died in 1165. These two AL-GHĀFIQĪ were probably contemporaries, and possibly related (father and son?). With MEYERHOF's kind permission, I reproduce AL-GHĀFIQĪ's will verbatim.

"I say—help comes from Allah—that he, who desires to be a real doctor, must inspire himself with the recommendations of the celebrated HIPPOCRATES which he left in his oath to the doctors of posterity. His first recommendation was to honour their professors, to take care of them, to show them gratitude, to render them the same filial devotion as they owed to their own parents, to share their own success with them; for they are professors, thanks to their nobleness of mind, their intelligence and their superior knowledge of science. You must, moreover, consider the children of your professors as your own brothers, as the children of your parents.

A doctor must care for the sick, giving them the best remedies and food. His object must never be to enrich himself but to gain the consideration of his contemporaries and heavenly recompense. That is why he must be pure and upright, pious, devout, soft-speaking, of exemplary conduct and far from dissolute living. He must never look on woman, slave or free, with immodesty. His sole preoccupation must be to visit the sick and try to cure them and as completely reestablish their health as possible.

It is forbidden to you, O! my sons, to divulge anything about your patients whether treatment or otherwise. You must reveal it to neither their relatives nor strangers. For there are many sick, who hide their illness from their parents or their families, and only confide in their doctor. That is why a doctor should be discretion itself.

A doctor must be prepossessing and charitable, soft-speaking, accessible and keen on caring for the poor and indigent sick. He must ask them neither salary nor recompense. On the contrary if he can get them remedies at his own expense he must do so and if that is not possible he must prescribe remedies and food which they can afford and visit them without charge morning and evening."

Query no. 41.—Apropos of IBN SĪNĀ's "Meccan" Qānūn—I was much surprized to find in the Arabian Nights (2nd Calcutta ed., vol. 1, 423, 1839) a reference to Al-qānūn al-makkī of IBN SĪNĀ: AVICENNA's Meccan Canon. What could that mean? Before publishing this question I communicated it to my friend and murshid Dr. D. B. MACDONALD, who has been engaged for years in a deep study of the Nights. Dr. MACDONALD kindly answered that the expression occurs not simply in Calcutta II but in Būlāq II and in the Jesuit edition. "The MSS. lying behind Būlāq I and II, Calcutta II and the Jesuit edition are different but are of the same recension, that which I have called ZER. It rather looks as if fī-l-ṭibb had been corrupted into al-makkī." Of course such a mistake is always possible, though in the Arabic script there is a considerable difference between the words fī-l-ṭibb and al-makkī; they cannot possibly be written to look alike.

Is there no other explanation? Assuming that a mistake was made

was it not due to a confusion of ideas rather than to a confusion of words, the sanctity of Mecca being so-to-say transferred to the great medical bible of Islām? Are there other instances of a similar use of the epithet al-makkī? The examples given in DOZY's Supplément (2,606) are clearly of another kind.

33.06.11 GEORGE SARTON.

Query no. 42.—Who is AL-SĀHIR, author of a medical compilation?

Miss WELBORN, who is investigating mediaeval Latin metrological treatises drew my attention to an authority frequently quoted, e.g., by DINO DI GARBO, as "ALSEIR." She traced it back to AVICENNA's Canon, Liber V summa II tractatus VIII (Latin edition of Venice 1582, p. 1039) wherein a chapter is entitled: "Descriptio ponderum et mensurarum ex breuiario alseir, id est vigilis."

Referring to the Arabic text (Būlāq 1294, vol. 3, p. 441) I found that this short chapter on weights and measures is taken from the kunnāsh of AL-SĀHIR. AL-SĀHIR means the vigilant, but I do not recall any Syriac or Arabic author bearing that name or epithet, nor have I found any trace of it in the reference books available to me.

GEORGE SARTON.

Answer no. 42. *As-Sāhir.* I have here no reference-books, but I know that AS-SĀHIR is one of the "minor" translators of the ninth century of our era in Baghdād. He is mentioned by IBN ABĪ UṢAIBI'A (e.g., vol. I, p. 203 if my memory does not deceive me) and many others. He is frequently quoted by AR-RĀZĪ in his *Ḥāwī* (Continens) and by others (I think by Pseudo-*Thābit*, ed. SOBHY, etc.). Nothing of his scientific output survived, neither translations nor own productions (e.g., his *Kunnāsh*). He was a Christian priest and physician and was called "the wakeful one" because he was prevented from sleep by a tumour in his head. You may find more information in IBN ABI UṢAIBI'A and LECLERC (vol. I, 302).

(*Tarporley, Cheshire.*) MAX MEYERHOF.

According to IBN ABĪ UṢAIBI'A (1, 203), his real name was YŪSUF AL-QASS (Joseph the priest) and he lived under AL-MUKTAFĪ (caliph from 902 to 908). G. S.

Query no. 43. *Earliest monumental use of Arabic numerals.* According to H. G. DWIGHT: *Constantinople, old and new* (London, 1915, 104) one of the mosaics of Kahrieh jami—the one representing the Marriage at Cana, in the central bay of the outer narthex—bears

the date 6811 in Arabic numerals of the Arabic form. That Byzantine date corresponds to the date 1303 of our era. It was not seen by TH. SCHMIDT nor by DIEHL. This suggests the following queries :

(1) Is the date 6811 actually included in that mosaic? It cannot be seen in DWIGHT's reproduction of the original photograph (by SÉBAH and JOAILLIER). We would be grateful to the Istanbul friend who would kindly examine the mosaic for this very purpose. A new visit to that charming little mosque is always worthwhile on many grounds.

Of course the date is plausible enough. It is said the mosaics were made c. 1310-20 by order of the great logothetes THEODOROS METOCHITES (1), but they might have been begun earlier for METOCHITES flourished at the Byzantine court from 1290 to 1328.

(2) Assuming that DWIGHT's assertion is confirmed, is this date (1303) the earliest example of the monumental use of Arabic numerals? No earlier ones are mentioned by D. E. SMITH and L. C. KARPINSKI : *The Hindu-Arabic numerals* (Boston 1911) or by G. F. HILL : *The development of Arabic numerals in Europe* (Oxford 1915).

The existence of an Arabic date in these mosaics would confirm their Syrian, or at any rate, their oriental origin. I may recall that GIOTTO's frescoes in the Chapel of the Annunciation in Padua were probably begun in 1306. However, the influence of his genius was felt before that time ; in 1306, GIOTTO was at least thirty years old and more probably forty and he had already proved his worth. GEORGE SARTON.

Query no. 44.—*Theobaldus Anguilbertus.*

The *Mensa Philosophica*, first published in 1475 at Cologne, is a little book describing the food, guests, and conversation for a banquet for philosophers. The first and one later edition indicate that the work was edited by THEOBALDUS ANGUILBERTUS, but other early editions attribute its authorship to him. An alternative ascription in several editions after 1489 is to MICHAEL SCOT. The book was obviously written not long before 1475, for it names a Franciscan who died in 1468. The many allusions in the fourth book of the *Mensa* to Dominicans have led several scholars to believe that a Dominican composed the work. Yet the seeming familiarity of the author with Greek physicians and Arabian scientists may well indicate that a physician wrote it. And ANGUILBERT is described in the edition of Paris in 1500 as an Irish doctor of medicine and arts. Dominicans themselves think that it is extremely unlikely that an Irish physician should have been a member of the order,

(1) For general information on the mosaics and bibliography see CHARLES DIEHL : *Manuel d'art byzantin* (2d. ed., 793-804, 1925).

though nothing whatsoever is known of ANGUILBERT apart from the allusions to him in this book.

Has anyone uncovered a reference that identifies ANGUILBERT, or positive evidence that he did not write the book, or any clue as to its authorship? Perhaps some record of a degree conferred on him could be found in the university records of Paris, since allusions to Paris and to Frenchmen in the book may indicate that its author had been in residence there.

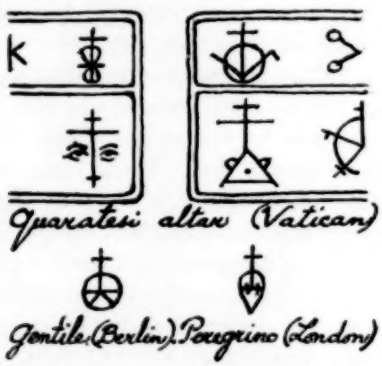
(Washington University, Saint-Louis.) THOMAS F. DUNN.

Query no. 45.—*Mysterious alchemical (?) or astrological (?) symbols in paintings of the school of Gentile da Fabriano (first half of the fifteenth century).*

In the course of a recent visit to the Metropolitan Museum of New York I noticed a little panel by the Florentine painter BICCI DI LORENZO which strangely enough had never arrested my attention before though it was given to the Museum as early as 1916 by FRANCIS KLEINBERGER. It represents St. NICHOLAS resuscitating the three boys. See our pl. published with the Metropolitan's gracious permission. What is the meaning of the symbols painted on the wall? A description of them is unnecessary as our illustration reproduces them very clearly.

Before publishing this query I wrote to the Museum for private information and received a very interesting and courteous reply from Miss MARGARETTA M. SALINGER, dated January 3, 1934. Says Miss SALINGER:

"In my research for the new catalogue of paintings, I have made a study of the BICCI DI LORENZO panels, and your letter of inquiry about them has therefore come to me.



"Possibly you did not know that these panels are a free adaptation by BICCI of the predella for the altar that GENTILE DA FABRIANO had

Isis, XXII, pl. 14. BICCI DI LORENZO : St. Nicholas resuscitating the three boys G. SARTON
(Courtesy of Metropolitan Museum, New York)

executed in 1425 for the QUARATESI family. (The GENTILE predella is in the Vatican). I enclose a drawing of the symbols which GENTILE painted on the wall of his inn, and you will note that they differ a little from ours. The scene however, is similar; St. NICHOLAS is shown resuscitating the three children who had been corned by the inn-keeper. I may add that single similar signs appear twice elsewhere in the school : on GENTILE's Madonna and Saints (Berlin) among the flowers on the ground and on PEREGRINO's Madonna (Victoria and Albert Museum).

" The signs on this museums' panel show a striking resemblance to water marks and to printer's marks. These latter however, occur with the advent of printing after 1450, and although the water marks are earlier, a common origin is more probable than a direct dependence.

" A number of the signs may be identified with figures in HAROLD BAYLEY's *The lost language of symbolism* (2 vols., London, 1912, cf. figures 101, 129, 175, 284, 422, 662, 693, 1313, etc.) I believed for a while that the tablets were calendars, the crosses marking saints' days, since hieroglyphs of this general type are found on the ' clog ' calendars. I now believe that they are necromancer's tablets, which helped the inn-keeper to effect his evil purposes, or at least cabalistic signs of use to him in his profession. See CHARLES NISARD, *Histoire des livres populaires ou de la littérature du colportage depuis le XVe siècle jusqu'à* 1852 (2 vols., Paris 1854, vol. I, p. 203)."

In addition to the two works above mentioned I have consulted the symbols reproduced by CARDAN, in HIERONYMI CARDANI *Opera* (vol. 3, Physica, Lugduni 1663) : De rerum varietate; Liber XVI, De rebus praeter naturam admirandis, Caput XC, Ars magica artefij et mihemii (p. 312-3) and Dr. LÜDY jun. : *Alchemistische und chemische Zeichen* (Gesellschaft für Geschichte der Pharmazie, 1928; *Isis*, 13, 232). LÜDY's collection of symbols is very rich. However I failed to identify the symbols of BICCI's panel. Their use by two painters who flourished at the same time and originated from the same Italian country (Marche), and by their contemporary, the Florentine BICCI, is significant (1). These symbols cannot be meaningless; what then do they stand for?

In an additional letter dated March 6, 1934 Miss SALINGER draws my attention to a third possibility : mercantile symbols. This was suggested to her by the symbols represented in *Florentine merchants in the age of the* MEDICI. *Letters and documents from the Selfridge collection of Medici Mss.* edited by GERTRUDE RANDOLPH BRAMLETTE RICHARDS (Cambridge, Harvard Press, 1932, p. 321, plates of p. 60, 188). I repro-

(1) BICCI DI LORENZO (Florence 1373—Florence 1452). GENTILE DA FABRIANO (Fabriano near Ancona, c. 1370, Rome 1427). PEREGRINO (fl. c. 1428).

duce the mercantile signs of various Florentine merchants as given by

LIST OF MERCANTILE SIGNS

1. Piero Venturi and Company

2. Francesco Galilei and Company

3. Neri Venturi

4. Neri Venturi, Francesco Galilei and Ser Nicolo Michelozzi

5. Neri Venturi, Ser Nicolo Michelozzi, and Giovanni Acciaiuoli

6. Giovenco de'Medici

7. Raffaello de'Medici

8. Francesco de'Medici

Miss RICHARDS on p. 321; some of those signs are strikingly similar to some signs of the BICCI panel. GEORGE SARTON.

II. — MISCELLANEA

Science in the fourteenth century.—We hope to publish a checklist of the articles and notes concerning the fourteenth century which have hitherto appeared in *Isis*. The list is ready, but our journal is so overcrowded at present that we thought it better to postpone its publication and thus make more room for other materials. We beg authors of

books or papers dealing with the fourteenth century science and thought to send them to us as promptly as possible, in order that we may be able not only to register them in *Isis*, but also to take them into account and eventually to discuss them in volume three of SARTON's *Introduction to the history of science*, which is now on the stocks.

THE EDITOR.

The Sator-Arepo formula.—This famous mediaeval formula to which ERNST DARMSTAEDTER devoted a very interesting study in *Isis*, 18, 322-29, 1932, occurs also in Ethiopic. The Abyssinians obtained it from the Coptic into which language it was rendered from a Greek transcription of the Latin. This is a good example of the extraordinary power of diffusion of magical and nonsensical words. HIOB LUDOLF: *Commentarius* (Francfort, 1691). Sir E. A. WALLIS BUDGE: *History of Ethiopia* (vol. 2, 586, 1928). SARTON.

The cure of "canis rabidi morsus" by means of the Sator-Arepo formula, written on a crust of bread, is discussed in CARDAN's *De rerum varietate* (1557), lib. VIII, cap. XLIV (Cura morborum superstitiosa).

A. P.

John Tolhopf alive in 1485. — The following passage from the Register of loans of the Vatican library during the pontificate of SIXTUS IV shows that the JOHN TOLHOPFF or TOLHOPF who addressed his *De motibus celestium mobilium* (1) to that pope was an entirely different person from JOHANN MÜLLER or REGIOMONTANUS whom he survived by at least almost a decade, since on January 18, 1485, he borrowed from the Vatican the book of the abbot JOACHIM on JEREMIAH and EZEKIEL.

"Ego JOANNES TOLHOPFF accepi a domino priore bibliothecario librum abbatis JOACHIM super libros JHEREMIAM et EZECHIELEM ex membranis in rubeo, ex bancho primo, cum cathena, in cuius pignus ego reliqui quatuor aureos apud dominum JOANNEM CHADELLI custodem, die xviii januarii 1485." (2)

TOLHOPF's interest in the prophecies of JOACHIM as well as in astronomy is also noteworthy. He returned the volume on February 25th.

Columbia University, LYNN THORNDIKE.
New York City.

(1) Concerning this work see my *Science and Thought in the Fifteenth Century*, New York, 1929, Appendix 16 (pp. 298-301) and Plate I, "JOHN TOLHOPF's Scheme of the Movements of the Heavens."

(2) MÜNTZ et FABRE, *La bibliothèque du Vatican au XV^e siècle*, 1887, p. 294. The passage was called to my attention by my research assistant, Miss PEARL KIBRE. There seems to be no mention of TOLHOPF in the Roman diaries of that time such as those of VOLTERRA, BURCHARD, CHIESA and INFESSURA.

Chemical note to the Edwin Smith Papyrus. — In the very interesting survey of the chemical contents of the Edwin Smith Papyrus, Prof. E.O. VON LIPPMANN (1) has suggested that the word imru, otherwise unknown in the literature of Egyptology, means alum. This material, however, is probably represented by the word ibu in the Ebers and Berlin medical Papyri, as was suggested by LORET (*Recueil de Travaux relatifs à la philologie et à l'archéologie égyptiennes et assyriennes*, 15, 199 (1893). Ibu, the coptic obeu, had been correctly identified with alum by the very arbitrary but learned Jesuit ATHANASIUS KIRCHER (1602-1680), from an Arabic treatise of IBN AL BAITAR, as LORET points out. In the Ebers Papyrus it is a constituent of a collyrium prepared according to a recipe of a Phoenician of Byblos, containing twelve constituents, and in the Berlin Papyrus it is a remedy for eruptions, as in DIOSKORIDES (2, 101; cf. LIPPMANN, *Abh. u. Vortr.*, 1, 60), where it is used, as in the Edwin Smith Papyrus, with honey. The translation " metal " by JOACHIM (Papyrus Ebers, 1890, 99; abennu = obeu) is no doubt due to the determinative for " mineral " used in hieroglyphics (cf. *μέταλλον*, originally mine, then mineral, finally metal). Mr. S. R. K. GLANVILLE, of the British Museum, informs me that, since the language of the Edwin Smith Papyrus is archaic, the use of imru and ibu for the same material in this and in the later Ebers Papyrus, respectively, is quite possible, and the two words may represent different stages in the development of the language. It appears that the identification proposed by Prof. E. O. VON LIPPMANN is very probable from the chemical evidence and is not in any way excluded on philological grounds.

(London.) J. R. PARTINGTON.

The History of Science Movement in Washington, D. C.—When the History of Science Society meets in Washington, D. C. during the coming Christmas season of 1934 to celebrate its tenth anniversary, it will also celebrate the first anniversary of what may be termed its first offspring, the Washington-Baltimore Section of the History of Science Society. The parent society was organized in Boston, Mass., January 12, 1924 and it is an interesting coincidence that on January 10, 1934, nearly ten years to a day later, the first local section came into being. On that day a small group of members of the History of Science Society met at the Cosmos Club in Washington to discuss the advisability of meeting informally to foster our common interest, stimulate activity in the move-

(1) In *Chem. Zeit.*, 55, 933, 1931. For the Papyrus in general see *Isis*, 15, 355-67, 1931.

ment and study of the history of science and to entertain distinguished scholars and students of our subject who may from time to time visit our city.

Present at this meeting were Dr. C. A. BROWNE, Chief of the U. S. Bureau of Chemistry and Soils; F. E. BRASCH, Secretary-Treasurer of the History of Science Society; Dr. J. F. COUCH, Bureau of Animal Industry; Dr. C. L. SHEAR, Bureau of Plant Industry; WATSON DAVIS, Director of Science Service; Dr. S. F. BEMIS, Department of History, George Washington University; O. A. MORGNER, Bibliophile; R. LEGEAR and M. C. LEIKIND of the Library of Congress.

An informal organization was agreed upon and Dr. J. F. COUCH and M. C. LEIKIND were elected Chairman and Secretary respectively. In view of the fact that about forty members of the History of Science Society are distributed between Washington and Baltimore it was decided to call this section the Washington-Baltimore Section. The first regular meeting took the form of a dinner in honor of GEORGE SARTON, Research Associate of the Carnegie Institution of Washington and Editor of *Isis*. Thirty eight membres, including a delegation from Baltimore, were in attendance at this most successful meeting, which was held in the Cosmos Club on the evening of January 27th.

The list of guests and speakers included, besides Dr. SARTON, Dr. JOHN C. MERRIAM, President of the Carnegie Institution of Washington; Sir HENRY WELLCOME of London, England, founder of the Wellcome Museums in the History of Science and Medicine; Professor HENRY E. SIGERIST, Director of the Institute of the History of Medicine of the Johns Hopkins University; Dean DOROTHY STIMSON of Goucher College; Dr. FIELDING H. GARRISON, Librarian of the Welch Medical Library and Dr. C. A. BROWNE, Chief of the U. S. Bureau of Chemistry and Soils.

The response and interest shown at this first meeting was so enthusiastic that we hope our example may serve as a stimulus for the formation of similar groups in other cities. It is by the organization of local chapters which will meet at frequent intervals during the year that the real influence of the History of Science Society will begin to assert itself.

The growth of the History of Science movement is indicative of the fact that history is no longer the exclusive domain of the social scientists and philosophers. The importance of the History of Science as one of the foundation pillars in the History of Civilization and Culture is being given increasing recognition not only by individual scientists and scholars but by the curriculum making bodies of colleges and universities.

At a time when extreme specialization seems to be destroying the

cultural and humanitarian aspects of science, the field of the history of science provides the one meeting ground where students of special sciences may meet and talk a common tongue. For, to quote Dr. SARTON, " The history of science is the history of mankind's unity, of its sublime purpose, of its gradual redemption."

We of the Washington-Baltimore Section hope that when the History of Science Society meets in Washington at the end of the year we will be only one of a large number of local sections.

Washington-Baltimore Section MORRIS C. LEIKIND,
History of Science Society *Secretary.*
Library of Congress.

Uppsala. — *Une chaire d'histoire des sciences et des idées* a été créée en nov. 1932 à l'Université d'Uppsala par la donation d'une somme de 350.000 couronnes suédoises, faite par un mecène connu de Stockholm, M. GUSTAF CARLBERG (mort nov. 1933). Le gouvernement suédois a nommé son premier titulaire JOHAN NORDSTRÖM, auparavant « docent » d'histoire littéraire à l'Université d'Uppsala.

III. — PERSONALIA

Professor D. F. FRASER-HARRIS, for an essay entitled " Antiseptics before LISTER," has been awarded by the University of Glasgow the triennial prize in the history of medicine. Note from ***Science***, 78, p. 87, 1933.

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David Eugene Smith in Persia.—Dr. D. E. SMITH, historian of mathematics, founder of our society, travelled considerably in Persia, 'Irāq and Syria, during the winter and spring of 1932-33, collecting Islamic Mss. He delivered various lectures in Persia and was decorated by the Shāh with the gold star of the Order of Elim. For further information see F. E. BRASCH in *Science* (vol. 78, 384, 1933). Dr. SMITH's mathematico-historical collection, which he has given to Columbia University, is one of the richest in the world,—certainly the richest ever gathered by a single individual. G. S.

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On June 18, 1934, Brown University in Providence, Rhode Island, conferred upon Dr. GEORGE SARTON, Editor of *Isis*, the honorary degree of Doctor of humane letters (LHD).

Reviews

Marcella Rigobon.—*Il Teatro e la Latinità di* HROTSVITHA. In-8° raisin. XII+42 pp. Editions Cedam, Padoue, 1932.

Une recrudescence d'intérêt à l'égard des écrits de la savante religieuse allemande HROSVITA s'est produite ces dernières années à la suite de la découverte de deux mss. de ses drames (à Klagenfurt, partie du drame *Sapientia* ; à Cologne quatre drames). Jusqu'alors on ne possédait que le seul ms. de Munich. FRENKEN nous a donné les variantes de ms. *colon* en 1922 (*Archiv der Gesellsch. f. ältere deutsch. Gesch.*, Berlin) et KARL STRECKER les a incorporées dans sa seconde édition du texte latin (TEUBNER, 1930). Développements précieux pour un travail philologique comme celui de Mlle RIGOBON dans sa thèse de doctorat. Ayant été terminée en 1929, cette thèse a pu profiter de FRENKEN, mais pas de la nouvelle édition de STRECKER, ni du travail de E. M. NEWMAN, *The Latinity of the Comedies of Hrotsvitha*, Chicago, 1929.

Le latin de HROSVITA a déjà été étudié, mais toujours d'une façon partielle. Mlle RIGOBON a soumis la première *tous* les travaux de HROSVITA au scrutin philologique, et avec grand soin. Sur le lexique, la morphologie et la syntaxe elle a des pages pleines d'intérêt. On regrette même qu'elle se soit attardée aux neuf premières pages à examiner le " théâtre " de HROSVITA au lieu de se concentrer sur la philologie. Mlle RIGOBON a fait bon usage des grands dictionnaires et de travaux indispensables comme ceux de TRAUBE. Mais elle n'a pas pensé à examiner le latin de la *Règle de St. Benoît* ; pourtant, HROSVITA étant bénédictine, il est bien clair qu'elle connaissait la règle à-peu-près par cœur. Quand donc nous trouvons *districtio* dans *Callimachus*, IX, 6, le sens peut très bien être " sévérité," car dans la Règle il est parlé de *districtiori disciplinae* (Cap. 34) et *districtio regulae in alimentis* dans le sens de sévérité, comme d'ailleurs dans CASSIEN (1). Puis, d'une façon générale, il y aurait avantage à comparer le latin des *Dialogues* de ST. GRÉGOIRE LE GRAND, travail d'un caractère très bénédictin.

(1) Voir BENNO LINDERBAUER, OSB, *S. Benedicti Regula Monachorum, herausgegeben und philologisch erklärt* (Metten, Autriche, 1922); cf. aussi DIEHL, *Inscrip. lat. christ. vet.*, N° 1024 (1925).

Mlle RIGOBON ne mentionne pas l'édition de HROSVITA dans la patrologie de MIGNE ; sans doute elle est fautive, (comme aussi son assez long *Index latinitatis in Hrots. Opera*) ; mais ce tome-là (comme le précédent) contient aussi une foule d'écrits d'auteurs contemporains, qui pourraient prêter à d'heureux rapprochements linguistiques. Mlle RIGOBON a écrit une belle page sur le mot extraordinaire *mansurnus* (= *annus*), mais elle n'a pas traité l'expression *fragmina testis* (= *reliquiae martyris* !), ni *undiquessecus*. HUGH BÉVENOT.

José Toribio Medina.—*The Discovery of the Amazon.* According to the Account of Friar GASPAR DE CARVAJAL and other Documents as published with an Introduction by JOSÉ TORIBIO MEDINA. Translated from the Spanish by BERTRAM T. LEE. Edited by H. C. HEATON. American Geographical Society, Special Publication No. 17. XIV+467 p. 3 facsim., map. New York, American Geographical Society, 1934. (Bound, $5.00).

The presence of fresh water off the equatorial coast of Brazil led VICENTE YÁÑEZ PINZÓN to the discovery, in 1500, of the mouth of a great river. PINZÓN's designation, Mar Dulce, applied, apparently, to the delta which he visited, not to the unknown Río Grande. Both names appear in a document dated 1501; on JUAN DE COSA's world map, 1501, the mouth of the river is designated as Mar Dulce. The name Marañón—of obscure origin—appears in documents as early as 1513; by the end of the third decade, the name Marañón seems to have been in common use, superseding the designations Mar Dulce and Río Grande.

ORELLANA's discovery, in 1542, of the course of the Marañón belongs to the most dramatic episodes in the history of geographical exploration; it was an unexpected result of GONZALO PIZARRO's disastrous expedition to La Canela, the Land of Cinnamon, east of Quito.

When FRANCISCO DE ORELLANA (ca. 1511-1546) left Santiago de Guayaquil, on the Pacific coast, in February, 1541, in order to join GONZALO PIZARRO's expedition, he could not foresee that a year and a half later, in August, 1542, he would reach the Atlantic coast after the first crossing of the continent in the equatorial region. Incidentally, the voyage down the Marañón took place between Saint Eulalia's day, February 12, 1542, and Saturday, August 26, 1542, when ORELLANA's brigantines, " Victoria " and " San Pedro," put out to sea; the year, 1541, generally indicated in historical treatises and reference works, is therefore wrong; neither MEDINA nor his translator or editor seem to feel the need of calling the reader's attention to this correction. Let us return to GONZALO PIZARRO's expeditionary force of some two hundred and fifty Spaniards who found themselves, by the end of December,

1541, in a desperate situation on the banks of the Napo or Cinnamon River. ORELLANA volunteered to go down the Napo in search of food which, according to the native guides, could be found a short distance downstream; he expected to return to the main body of the expeditionary force within ten or twelve days.

ORELLANA's emergency expedition consisted of about sixty men in several canoes and a small brigantine previously built by PIZARRO's men. It took ORELLANA's party nine days to reach a village where they decided to stop and get food; "not being able to go back upstream on account of the force of the currents and the heavy rains and the bad weather conditions and the skirmishes with the Indians," they decided to wait for PIZARRO and his men; ORELLANA's party waited in the village from January 3 to February 2, 1542—then they continued their voyage downstream, into the unexplored country, back to civilization. It cannot be denied that ORELLANA abandoned GONZALO PIZARRO and his men to their fate; but, in the light of the documentary evidence produced and interpreted by JOSÉ TORIBIO MEDINA (1852-1930), ORELLANA's actions cannot be characterized as "treason." GONZALO PIZARRO and about eighty companions returned to Quito in June, 1542.

ORELLANA's Odyssey ended on the island of Cubagua, off the coast of Venezuela, where he arrived, in September, 1542, with about forty companions. From the point of view of the history of geography, 1542 marks the beginning of our knowledge of an important river basin the exploration of which remains difficult and incomplete even now. ORELLANA's second expedition, 1545-1546, organized in Spain for the conquest and settlement of the newly discovered territory in New Andalusia, was a complete failure: ORELLANA and more than three hundred adventurers lost their lives without contributing to the expansion of the Spanish empire or of the contemporary knowledge of the lower Amazon valley.

ORELLANA's official account covering his descent, by water, from the eastern slopes of the Cordilleras to the Mar del Norte, is lost. One of the members of his expedition, the Dominican friar GASPAR DE CARVAJAL (ca. 1504-1584), wrote a detailed and fair report on the voyage of discovery down the great river, but his account remained practically unknown for more than three centuries. One version of CARVAJAL's account was added by GONZALO FERNÁNDEZ DE OVIEDO Y VALDÉS (1478-1557), the first official chronicler of the Indies, as chapter 24 to the revised manuscript of his *Libro de infortunios e naufragios* (which forms book 50 of his *Historia general y natural de las Indias*), and was first published by JOSÉ AMADOR DE LOS RIOS in 1855; another version of CARVAJAL's account was published by JOSÉ TORIBIO MEDINA, in 1894/95, from

a XVIth century manuscript in the possession of the duke of T'SERCLAES DE TILLY (and from an incomplete transcript of this version in the Royal Academy of History in Madrid). A study of the differences between these two versions led H. C. HEATON to the conclusion " that CARVAJAL himself wrote the account twice, but with his first manuscript (or a copy of it) before him while he was writing the second version, copying the first with only slight changes in phraseology whenever he was satisfied with the text before him, but most often revising his own work completely, perhaps occasionally rectifying an error." The version included by OVIEDO in his *Historia* appears to be the " revised " one.

Unless the version published by MEDINA represents the result of XVIth century editing which eliminated from some copies of the " original " account certain passages preserved in the " revised " version, we must admit that CARVAJAL's " revision " was not always an improvement. The preposterous Orinoco hypothesis may serve as an illustration. In the MEDINA version we read, toward the end of CARVAJAL's account (p. 234) :

" ... of this river, which we hold to be the Marañón, because the distance from the mouth as far as the island of Cubagua is four hundred and fifty leagues by latitude, for so we figured it out after we arrived."

In the OVIEDO version, CARVAJAL seems to be less emphatic, though more verbose (p. 446) :

" As to this exceedingly large river, with all my attempting with much eagerness to get some information regarding it from men who have traveled on this coast of Tierra Firme and have gone up some of its rivers, I have not been able to convince myself definitely which of two rivers it is, because some say that it is the Huyapari [i.e., Orinoco] and others the Maranon; for there is a distance of four hundred leagues to this Island of Cubagua from where we went out to sea; and, as we have already seen, the whole river taken together, there where we entered... the sea, has a width of more than forty leagues, and there is a rise and fall of the tide at the mouth of more than five fathoms."

MEDINA's *Descubrimiento del Río de las Amazonas* según la relación hasta ahora inédita de Fr. GASPAR DE CARVAJAL con otros documentos referentes á FRANCISCO DE ORELLANA y sus compañeros... con una Introducción histórica y algunas ilustraciones (Seville, 1894; colophon : 1895) consists of three parts : MEDINA's Introduction (233 p.), CARVAJAL's Account (81 p.; MEDINA's notes to it, 8 p.), and nineteen groups of Documents (182 p.)—nine groups relating to ORELLANA's descent of the Marañón, the remaining ten relating to his disastrous expedition to New Andalusia. MEDINA's Introduction, based on the hitherto neglected or unknown documentary evidence, must be considered as

a successful attempt to rehabilitate the memory of ORELLANA who was a victim of circumstances rather than a traitor. MEDINA's thesis would have received wider diffusion if it were not for the fact that the edition of his book was limited to two hundred copies : the ghost of the " one-eyed traitor " still haunts the more accessible places where general information concerning ORELLANA might be gathered—e.g., in ESPASA's *Enciclopedia universal illustrada* (40, 255-56, 1920?). The present publication of the American Geographical Society will help to acquaint the general reader with MEDINA's interpretation of ORELLANA's career.

The translator, BERTRAM T. LEE, gives a literal but quite readable version of MEDINA's book. The editor, H. C. HEATON, has added, in an Appendix, his own translation of extracts from books 49 and 50 of OVIEDO's *Historia :* OVIEDO's description of ORELLANA's two expeditions and the already mentioned " revised " version of CARVAJAL's Account. Both the translator and the editor contributed signed footnotes of their own throughout the book, as well as signed additions to MEDINA's numerous footnotes. The editor's task in checking MEDINA's quotations and bibliographical references was not an easy one, because the untiring Chilean historian must have worked, in 1894, at a speed incompatible with absolute accuracy. The editor, a New Yorker, can hardly be blamed for leaving unchecked such items as the date of a letter in the Archives of the Indies, in Seville (p. 13), or the reference to a manuscript in the National Library, in Madrid (p. 20), or the easily corrected error in MEDINA's reference to a letter in the Archives of Simanca (p. 125), although some correspondence with these institutions might have been advisable. On the other hand, the editor's statement (p. 80) that FRANCISCO DE JEREZ's *Verdadera relación* " was first published, in all probability, in 1534 " proves that he is not aware of the fact that one of the four known copies of this edition is in the New York Public Library; similarly, the editor would have avoided the use (p. 385) of an expression like " if one may trust the reprint of Salamanca, 1547," if he cared to visit the Library of the Hispanic Society—an arrow's shot from the American Geographical Society—where several copies of the CROMBERGER edition (Seville 1535) of OVIEDO's *La historia general de las Indias* can be found. If the translator went to the trouble of consulting documents (p. 20) in the National Archives of Peru, the editor could be expected to be more familiar with rare Americana easily accessible to New Yorkers.

The reviewer objects to the wording of the following footnote (p. 100) signed by the translator : " To this day the Amazon Indians will cut the timber they need for their building purposes only in the last quarter of the moon. They know from experience that timber cut in any other quarter will soon rot and be eaten by insects. Possibly this fact, coupled

with the use of inappropriate woods, caused the brigantine to need repairs so soon after its construction." Does the translator really believe that the phase of the moon—as distinguished from the season of the year—may influence the quality of the timber?

A carefully prepared map of ORELLANA's voyage and a good index increase the usefulness of the American edition. The facsimiles of the documents are, in the reviewer's opinion, not an improvement on the corresponding " ilustraciones " of MEDINA's book printed in Spain forty years ago.

The proofreading was done with extreme care—the book is almost free from misprints; the running title of the odd-numbered pages 99 to 107, " The voyage down the river," does not correspond to the title of chapter VIII, " The voyage of discovery " (MEDINA : " El viaje de descubrimiento ").

The typography is very satisfactory from a purely aesthetic point of view, but the choice of the fine type for the numerous and lengthy footnotes will be hardly welcomed by those readers who might care to consult them; taking into consideration the length of the lines in the book, the footnotes should have been printed in two columns—or, better still, in a readable type. A. POGO.

K. J. Franklin.—*De venarum ostiolis* 1603 *of* HIERONYMUS FABRICIUS OF AQUAPENDENTE (1533?-1619). Facsimile edition with introduction, translation and notes 98 p. Springfield, Illinois, CHARLES C. THOMAS, 1933.

In commemoration of the great Italian anatomist and surgeon, HIERONIMUS FABRICIUS OF AQUAPENDENTE, K. J. FRANKLIN, Tutor and Lecturer in Physiology of Oriel College, has prepared this facsimile edition of FABRICIUS' work " De Venarum Ostiolis." The book contains a biographical sketch of FABRICIUS and refers to his scientific career and his success as a teacher and surgeon, as well as to his private life. A picture is given of a man who went to the University of Padua at the age of seventeen, who obtained a degree of Doctor of Medicine at twenty-six and who stayed at Padua as a teacher of anatomy for fifty years. We learn about many people of his time to whom he was a medical adviser, how he taught students of all European nations in anatomy, and how he carried on successful research, publishing several important anatomical works of which one is " De Venarum Ostiolis."

In the second chapter the author discusses the early history of the work on venous valves. Before the sixteenth century venous valves were not known or at least were not accurately described. Several of the great men in medicine were credited with having mentioned venous

valves; it can, however, be shown that no certain knowledge was available before the sixteenth century. At that time apparently several physicians saw valves in the vena azygos. AMATUS states that they were demonstrated in 1547 at Ferrara. The discovery however was denied by VESALIUS, EUSTACHIUS, FALLOPPIUS and others and thus the study of venous valves received a set-back for some time. Other mention of valves in veins and their functions was made by CHARLES ESTIENNE in 1545 and by JACOBUS SYLVIUS in 1541. FABRICIUS thus had some information about valves if the literature was available to him or the vague accounts suggestive enough for further investigation. He states that " no one even set eyes on them till 1574 when to my great delight I saw them in the course of my dissection." According to BAUHIN and ALBERTI, FABRICIUS must have demonstrated the valves during his lectures in 1578-79. The fact that he delayed the publication of his discoveries until twenty-four years afterwards is rather surprising. ALBERTI had published the first account of the valves and had given some drawings earlier than the time when FABRICIUS' book appeared in print.

FABRICIUS' work adheres much to the ideas of GALEN and thus we must expect to find in the descriptions quite a few wrong conclusions drawn from the anatomical findings. And at this place it should be remembered that it was really HARVEY—who studied under FABRICIUS—who was fortunate enough to give the first complete and correct account of the circulatory system and the functions of its parts.

In the third chapter of the book we find a description of the amphitheatre of the school of anatomy at Padua with interesting plans of the construction, and a reproduction of a picture of FABRICIUS lecturing in his anatomical theatre.

The next two chapters deal with bibliographical notes concerning the first edition of the book, to which are added interesting references to the literature pertaining to FABRICIUS' life history and the earlier accounts about valves of veins.

The remainder of the book contains a translation of " De Venarum Ostiolis " and a facsimile reproduction of the original text with the plates and explanations of the figures. The translation is very literal. The Latin text of the original is not very smooth and thus the editor of the present book intended to give to the translation the same note which FABRICIUS gave to the original, which was probably due to the fact that FABRICIUS himself was not entirely clear about the details of the matter. Several thoughts carried through his book are quite incorrect according to the later advances of investigation. He relies too much on preconceived notions of the physiology of the movement of the blood through the body in his anatomical descriptions, with the result that

some of the anatomical findings had to be adjusted to fit such notions. On the other hand many questions are raised and interpreted wrongly because the real function of the veins,—namely to bring the blood back to the heart—had not yet been clearly stated at his time.

The seven plates are slightly reduced from the originals. The pictures are very clear but anatomically not altogether too correct. They give, however, a nice illustration of the skillfulness of a great anatomist of the sixteenth century.

Harvard University. E. WOLF.

George Boas.—*The happy beast in French thought of the Seventeenth Century.* (Contributions to the history of primitivism.) VII+159 p. Baltimore, The Johns Hopkins Press, 1933. Price $2.00.

Primarily this treatise traces the history of the opinions of the philosophers and later of the satirists as to the relative merits and happiness of man and the beasts. Attention is centered upon French opinion in the Seventeenth Century which grew out of MONTAIGNE's satirical theriophily, which rejected the whole tribe of man and maintained that true happiness was to be found only in the beasts, which were supposed to be wiser and nobler than their masters, models of prudence and decency, clever physicians and artists. These opinions became subjects of acute philosophical differences in the Seventeenth Century, which led to the extreme opinion that the beast is more natural than man and therefore superior, and that reason is a curse, and thus gave rise to morophily or anti-intellectualism. The other extreme was the philosophic materialism of the Cartesian school, which regarded the beast as merely a machine.

These philosophical views are reflected in the theriophily of the early zoologists. Thus RORARIO in his *Quod animalia bruta ratione* (1648), held, in the manner of the yarns of AELIAN and PLUTARCH, that the beasts reason better than man. GILLES, who is cited as the " first of the modern zoologists," in his *Ex Aeliani historia* (1533), also draws largely upon the ancients for his data, but develops the argument for the intelligence of the beasts. There were, however, skeptics exemplified in GUY DE BRUES' *Dialogues* (1557), in which it is argued that the beasts have neither reason nor intellect, memory nor anticipation, and in PONTUS DE TYARD's *Premier Curieux* (1587), in which he maintains that nature is *trop débile* to lead us to God and that Science alone distinguishes us from the beasts. The early naturalists were interested in animals because their lives were edifying, a view which lingers even into the Seventeenth Century in REAUMUR's *Histoire des Fourmis*, in FRANZIUS's *Historiae Animalium* (1612), ALDROVANDUS's *De Animalibus Insectis* (1602),

GOEDART's *Of Insects* (1682), and even lingers in SWAMMERDAM's *Book of Nature* (1737, but written before 1680). In REAUMUR's *Histoire des Insectes* (1734) we first really find objective observation free alike from moral or mechanistic deductions.

In the Eighteenth Century theriophily takes on new life, rids itself of literary satire and philosophical servitude, and emerges as pure biological theory in Buffonism and Lamarckianism.

January 3, 1934. C. A. KOFOID.

N. Bryllion Fagin.—*William Bartram, Interpreter of the American landscape*. XII+229 p. Baltimore, The Johns Hopkins Press, 1933. $2.25.

The purpose of the author is "to determine with some measure of comprehensiveness the influence of BARTRAM on the development of nature description, to show the special combination of gifts which he brought to his observation of the American landscape, and to discuss the factors outside of BARTRAM and his work which have contributed to his popularity among literary men, especially in Europe." The book falls into three subequal parts. The first is biographical, the second an analysis of the elements of BARTRAM's landscape, and the third a survey of BARTRAM's influence upon literature.

WILLIAM BARTRAM (1739-1823), son of JOHN BARTRAM, the Quaker botanist of Philadelphia, is chiefly known for his *Travels* (1791) through the Carolinas, Georgia, and Florida, in which he wrote of the natural history of these regions, and especially of the Indian tribes with whom he maintained friendly relations. As a source book in this field his writings have been recognized by later students of the North American Indians. He was also something of an ornithologist, a friend of ALEXANDER WILSON, and the author of *Anecdotes of an American Crow*. As a botanist he collected for European specialists, corresponded with LINNAEUS, and was led by his observations on the Venus Fly Trap, *Dionaea muscipula*, to attribute sensation and volition to plants. His humanitarian and religious views led him to regard all nature, even the rattlesnake, as benevolent, and were the mainspring of his enthusiastic appreciation of beauty in nature. This, added to his literary gifts, made his accounts of his travels peculiarly acceptable to English poets and essayists, such as COLERIDGE, WORDSWORTH, SOUTHEY, CAMPBELL, SHELLEY, LAMB, TENNYSON, and CARLYLE, to American writers, such as EMERSON, THOREAU, CHIVERS, and HEARN, and to CHATEAUBRIAND. Some of these, notably COLERIDGE, drew heavily upon BARTRAM not only for theme, but also for incident, and even verbal form.

One historical feature the author fails to elaborate, namely that

BARTRAM's *Travels* was published in the period of the great vogue of books of travel. Collections of travels were in demand, the South Seas were attracting notice, and BUFFON was just completing his oft-reprinted *Histoire Naturelle*. Poets and essayists were nature conscious. Disillusioned harakiri had as yet no place in literature!

August 14, 1933. CHARLES A. KOFOID.

Louis de Launay.—Un grand français : MONGE, fondateur de l'Ecole polytechnique. 280 p., 8 pl. Paris, P. ROGER (sans date, 1933 ?).

Nous devons déjà à l'auteur de ce livre en dépit de ses fonctions absorbantes d'inspecteur général des mines, et de professeur à l'Ecole supérieure des mines et à l'Ecole des ponts et chaussées, un bon nombre de publications géologiques et historiques, et son nom apparaît plusieurs fois dans nos bibliographies. Il suffira de rappeler ici sa biographie de DESCARTES (1923, *Isis*, 7, 214) et celle d'AMPÈRE (1924, *Isis*, 8, 564). La présente biographie est plus fouillée que les précédentes et l'auteur en indique le point de vue dans les termes suivants (p. 7) :

" Le nom de MONGE évoque aussitôt deux grands souvenirs : la création de la géométrie descriptive et la fondation de l'École polytechnique. C'est à ce double titre qu'il a été maintes fois célébré et nous aurons à insister, nous aussi, sur ces côtés essentiels de son œuvre. Mais nous voudrions pousser plus loin et, profitant de très nombreux documents inédits empruntés à des archives publiques et privées, nous désirons mettre du même coup en lumière d'autres aspects intéressants de cette vie qui ont été généralement négligés, passés sous silence ou ignorés. MONGE n'a pas été seulement un théoricien de la géométrie et de l'algèbre; il a été plus encore un homme pratique et un réalisateur. Ce caractère, qui apparaît déjà dans ses deux titres de gloire fondamentaux, se manifeste avec une évidence plus criante quand on envisage, comme nous allons le faire, l'ensemble d'une longue carrière aux activités singulièrement diverses, où la politique et l'administration ont tenu, à mesure que les années s'écoulaient, de plus en plus de place. Nous n'entendons pas écrire simplement une étude sur les travaux qui ont fait de MONGE un membre illustre de l'Académie des Sciences, mais un récit aussi complet que possible de toute son existence si bien remplie."

La partie purement mathématique est traitée assez superficiellement, et l'historien des mathématiques n'utilisera cet ouvrage que pour les faits biographiques et pour tout ce qui constitue le côté humain et l'atmosphère dans laquelle se développa l'étonnante activité de MONGE ; il le trouvera à la fois fort attachant et fort utile. MONGE fut un révolutionnaire ingénu et un admirateur aveugle de BONAPARTE et de NAPOLÉON, qui le récompensèrent largement de sa fidélité. Il fut chargé entre autres besognes de choisir les œuvres d'art, manuscrits, diamants et autres objets que BONAPARTE enleva à l'Italie et de les faire parvenir en France (1796-97). Quelquefois les Italiens avaient eu soin de dissi-

muler leurs trésors et le brave MONGE s'indigne de leur duplicité ! Par exemple il trouve maison vide à Lorette, tous les objets précieux en ayant été retirés par ordre du pape, et il a le toupet d'écrire (p. 158) :

" Il n'a laissé, comme un voleur, que ce qu'il aurait été trop long à décrocher !... Nous saurons au juste ce que cela vaut; car le général veut que nous assistions à la pesée de toute cette chaudronnerie... Quant au tableau de RAPHAËL qui nous a été volé indignement et contre toutes les lois de la guerre, il faudra bien que le pape nous le rende ! "

Il faut remarquer que ce pillage était fort éclectique, BONAPARTE ayant eu soin de s'entourer d'experts qui savaient déterminer ce qu'il y avait de plus précieux dans chaque domaine. (p. 170) :

" C'est ainsi que le Jardin des Plantes reçut les herbiers de HALLER et de ALDROVANDO, la collection des substances volcaniques de SPALLANZANI, des cristaux de roche, des fossiles, des marbres, une pépite d'or, etc.; l'École polytechnique, un microscope solaire et un microscope de nuit venant de Bologne, une chambre obscure en bois d'acajou et quelques ouvrages de science italiens. Cet envoi, destiné à l'École polytechnique, avait été spécialement choisi par MONGE, qui y joignit plus tard une machine électrique anglaise et une caisse de ' précipité rouge ' venant de Milan, ainsi qu'une collection des œuvres de PIRANÈSE achetée à Rome."

On ne sait ce dont il faut s'étonner le plus, de l'indignité inconsciente de ces déprédations ou de leur régularité administrative. Les armées de la République se glorifiaient d'apporter la lumière et la civilisation aux peuples étrangers et trouvaient tout naturel de les dépouiller à la fois de leurs tyrans et de leur patrimoine le plus précieux. Et quand elles n'étaient point reçues en libératrices héroïques, leurs chefs (tels que notre brave MONGE) s'en étonnaient et accusaient les peuples libérés et dépouillés d'ingratitude. Quant à la forme administrative elle était, nous dit-on, irréprochable (p. 167) :

" Une population de scribes imperturbables a continué à fonctionner à travers tous les désordres de la Révolution et peut-être avec d'autant plus de régularité dans la forme qu'il y avait plus d'irrégularité dans le fond. Les prélèvements n'avaient rien d'arbitraire, mais étaient strictement prévus par des traités : vingt tableaux au choix pour le duc de Parme, autant pour le duc de Modène, cent tableaux ou sculptures pour le pape, cinq cents manuscrits à Rome, autant à Venise avec vingt tableaux, etc. Et, quand il s'agit d'y ajouter quelque chose, on n'use pas de la force, mais on négocie par voie d'échange."

J'ai été très heureux toutefois d'apprendre (p. 149) que le 15 août 1796, l'élite des artistes français signa une pétition " contre cette forme de vol légalisé appliquée à des œuvres d'art, patrimoine insaisissable d'une nation."

Le chapitre le plus intéressant sans doute est celui consacré à la campagne d'Egypte (26 mai 1798-8 octobre 1799) que MONGE aida à préparer. Par exemple, pendant son séjour à Rome, il s'occupa de réunir la flotte nécessaire, de réquisitionner des presses d'imprimerie et la fonte arabe de la Propagande, et de raccoler les interprêtes *maronites* dont on aura besoin pour annoncer au peuple égyptien sa libération. Quelle fantastique aventure que cette expédition d'Egypte ! Je ne veux pas en examiner le côté militaire, mais je ne puis jamais m'empêcher d'admirer le génie dont BONAPARTE fit preuve dans le choix de ses collaborateurs scientifiques : BERTHOLLET, DOLOMIEU, GEOFFROY SAINT-HILAIRE, FOURIER, CONTÉ, MALUS, DENON, DESGENETTES, LARREY, MONGE, JOMARD, CHAMPOLLION... Que de gloire immortelle dans cet Institut d'Egypte si éphémère !

Le livre de M. DE LAUNAY nous donne de nouvelles preuves du goût sincère de BONAPARTE pour la science. Sans doute il se servait parfois de conversations scientifiques comme d'une protection pour se défendre et s'isoler des généraux, mais il aimait vraiment la science et comprenait les savants. GEOFFROY SAINT HILAIRE nous raconte que deux heures avant le départ de l'Egypte (départ qui était une fuite clandestine après l'échec complet) (1), on était réuni dans le jardin du général en chef (p. 221) :

" Il y avait là BONAPARTE, MONGE, BERTHOLLET, et aussi l'aimable M^me^ FOURÈS, habillée en hussard. Comme les préparatifs s'allongeaient, BONAPARTE engagea une conversation philosophique avec ses amis et se mit à leur parler de son passé : ' Je ne suis, dit-il, devenu militaire qu'à mon corps défendant. J'avais une autre ambition dans ma jeunesse et j'ai cru à mon étoile pour devenir, par mes inventions, un NEWTON... Depuis que j'ai rang dans l'armée, ce rêve de ma jeunesse me revient sans cesse à l'esprit et c'est là l'instinct qui me pousse dans mes loisirs aux leçons de BERTHOLLET, non plus pour réaliser ma chimère, mais pour en juger le caractère.' MONGE lui répondit qu'il avait assez de gloire sans cela et ajouta qu'en science on ne pouvait espérer recommencer NEWTON, parce que, selon un mot de LAGRANGE, il n'y avait qu'un monde à découvrir : ' Que dites-vous là ? répondit BONAPARTE avec vivacité. Il en est un autre et qui peut donner aussi une gloire colossale. NEWTON a découvert le problème des grandes masses de l'Univers placées à distance; mais cet autre monde, c'est celui des molécules-principes sans distance appréciable et de leurs affinités. Ma jeunesse visait là. L'utilité des découvertes de NEWTON n'était qu'une spéculation philosophique. Je voyais une application pratique pour l'humanité à connaître la vie intime de l'univers. ' "

Quelle vision sublime ! Je note aussi que dès son retour à Paris (15 octobre 1799) BONAPARTE adressa un billet à LAPLACE, son ancien

(1) BONAPARTE abandonnait son armée en Égypte et en transmettait le commandement à KLÉBER par écrit, sans oser lui avouer son départ.

examinateur à l'Ecole militaire, pour le remercier de lui avoir envoyé sa *Mécanique céleste* (vols. 1 et 2), et il assista aux séances de l'Institut du 23 et 27 octobre, du 2 et 11 novembre. Or entre ces deux dernières séances il fit le coup d'état du 18 brumaire an viii = 9 novembre 1799 ! Mais il faut que je m'arrête, et que je renvoie le lecteur au livre même où il trouvera maintes anecdotes intéressantes s'il veut bien les y chercher, car il n'y a pas d'index. Il y a à la fin du livre une liste des publications de MONGE et de ses manuscrits abondants conservés dans les familles MAREY-MONGE et ESCHASSERIAUX. GEORGE SARTON.

Louis Roule.—*Lacépède et la sociologie humanitaire selon la nature.* L'Histoire de la Nature Vivante d'après l'Œuvre des Grands Naturalistes français, VI. 244 p., portr. n.d. Paris, E. FLAMMARION, 1932. (Fr. 12).

This biographer of Comte de LACÉPÈDE regards him as one of the forgotten men of a brilliant period in French biology and one not without great influence politically during the Revolution and the Empire, an influence used repeatedly to develop the Jardin des Plantes with its museum of natural history and menagerie. He was descended from noble families of Burgundy and the Rhineland. His temperament was artistic, but he early turned from a career at court as musician and composer to that of collaborator with BUFFON on the neglected and difficult groups of reptiles and fishes as a humble member of the technical staff of the Museum d'Histoire Naturelle, where he was associated with CUVIER, DAUBENTON, GEOFFROY ST. HILAIRE, and LAMARCK. Although by instinct a recluse, he habitually sought the acquaintance of leaders, of GLUCK the musician, of FRANKLIN, and of BUFFON. His reputation as a counsellor grew. He was chosen for the National and Legislative Assemblies. MARIE ANTOINETTE pleaded with him to become the tutor of the dauphin. NAPOLEON as general and as emperor sought his advice and elevated him to the Chancellorship of the Legion of Honor. His loyalty to BUFFON absorbed the years of his prime in the painstaking completion of the *Erpétologie* and *Ichtyologie* in the mode of his scientific godfather. His real personal contributions are hidden in the elaborate prefaces to the volumes of these series, especially the latter, and in the methodology of his most mature work, *Histoire de l'Europe* (1826) published shortly after his death. ROULE characterizes this as an ethnic biology.

LACÉPÈDE's preoccupation in his later years in political life was based on his humanitarian and sociological proclivities and his views on the nature of man derivable from his intellectual outlook as a natural historian. His colleagues and biologists generally have been deflected from giving

to him adequate recognition, partly because of his later career in politics and history, and in part because his biological ideas were distributed in the prefaces to his works referred to above, but never gathered into a coherent presentation under a significant bibliographic title. ROULE credits him with insistence on the time factor in transformism, with a categorical formulation of the method of the natural historian, and with a recognition of the evolutionary factors of natural and artificial selection, the struggle for life, use and disuse, influences of the environment, the cyclic aspects of animal categories, regulation, and an organizing force. He does not, however, discuss the matter of priorities of publication of such views. In view of his scientific associates in the school of BUFFON, any such analysis must of necessity be merely comparative and be formal rather than real.

Aug. 14, 1933. CHARLES A. KOFOID.

Julius Schuster.—*Die Anfänge der wissenschaftlichen Erforschung der Geschichte des Lebens durch Cuvier und Geoffroy Saint Hilaire.* Eine historisch-kritische Untersuchung. *Arch. f. Geschichte der Math., der Naturwiss. und der Technik*, Bd. 12, Heft 3 ff. Durch Vorwort und Literaturverzeichniss vermehrte Ausgabe. VIII+180 p., 1 double pl., 15 figs. in text. Leipzig, F. C. W. VOGEL, 1930. Nicht im Buchhandel.

The scientific significance of the views of GEOFFROY SAINT HILAIRE, associate of CUVIER, has been overshadowed on the one hand by the dominance of this masterful comparative anatomist and the later overthrow of his concepts of special creation, the stability of species, catastrophism, and the four types, on the other hand by the importance of LAMARCK's ideas as a foil for the Allmacht of DARWIN's natural selection. The value of Dr. SCHUSTER's revival of the controversy between CUVIER and GEOFFROY SAINT HILAIRE lies in the fact that contemporaneously with the growth of CUVIER's power in the fields of comparative anatomy and palaeontology there existed in the Parisian group of scientific workers another anatomist and palaeontologist who was formulating a basically different interpretation, often of CUVIER's own data, an interpretation which in most objective features accords with the more seasoned and better founded views of the current period. This exhaustive study of the somewhat dispersed opinions of GEOFFROY SAINT HILAIRE opens with a critical statement of CUVIER's views on the law of correlation, the discontinuity of fossil and living species, his conception of the immutability of specially created species and of their migrations and exterminations due to geological catastrophes, and his theoretical view of the nature of the organic world.

Over against this group of ideas is arrayed GEOFFROY SAINT HILAIRE's defense of the derivation of modern gavials and crocodiles from fossil forms and the relationship of *Sivatherium* to the giraffe.

GEOFFROY SAINT HILAIRE's concept of transformism was concretely that of DARWIN's descent with modification, but it was accompanied by a somewhat metaphysical and romantic group of ideas based upon his universal law of *attraction de soi pour soi* or molecular attraction. To this he added his theory of analogues, or principle of identity, namely: Not organs in their totality, but the building stones (matériaux) out of which they are formed are alike. His second law, or dynamic principle, was the *principe des connexions*, namely, the parts themselves are not variable, but only their interlocking interconnections. His third law was the elective affinity of the organic elements. The whole does not form the whole, but there is a certain ordering of the parts. This theorem bears a certain resemblance to the gene hypothesis of today. The fourth law was the symmetry or balancing of organs, involving the principle of economy.

The combination of these four ideas of analogy, connection, election, and balance, gives rise to his fundamental idea of the unity of organic structure, a dim forecast of modern organicism. It was this basic concept by which he sought to make intelligible a dynamic organic system which could and did undergo changes in time. To the support of this idea he utilized the data from the study of human monstrosities, from the effects of domestication, and from the history of life.

The author diverges from his study of the two anatomists to trace the factors in the youth and career of each protagonist which influenced or revealed his intellectual tendencies. He gives an account of GEOFFROY SAINT HILAIRE's experiences with NAPOLEON's Expedition to Egypt, where he studied *Polypterus*, the lung fish, the two divergent types of electric fishes, and sought to link the to-be-expected changes in the Egyptian fauna and flora within historic times with those detected between fossil and living species.

With GEOFFROY SAINT HILAIRE's efforts to derive the Vertebrata from the Arthropoda and to develop the modern concept of homology, the cleft between the old friends widened rapidly between 1820 and 1832 with each succeeding criticism. This contest reached a climax in a series of discussions before the Academy of Paris in 1830 involving both details of comparative anatomy and the clarification of the opposed views. This discussion brought into the foreground the ideas of homology and its meaning in the doctrine of descent with modification. Incidentally the science of palaeontology was born and christened as

such by BLAINVILLE, and CUVIER turned the weapon of the history of natural science effectively against his opponent.

The author closes his account of this exciting debate with a general review of opinion on the more philosophical aspects involved in the discussion, such as *Naturphilosophie*, *Aristotelismus*, religion and the state, the personal characters of the contestants, and the current status of ideas in geology and palaeontology, uniformitarianism, the heritage from romanticism, and the place of DARWIN and HAECKEL.

The treatise closes with twelve historical excursions into the ideas of contemporaries of the two debaters, namely ISIDORE GEOFFROY SAINT HILAIRE, DUCHESNE, KIELMEYER, WILLIAM SMITH, CHARLES LYELL, VON BUCH and VON HUMBOLDT, REINECKE, QUENSTEDT, BRONN, JOHANNES MÜLLER, A. BRAUN, and MORITZ WAGNER. A bibliography of GEOFFROY SAINT HILAIRE's palaeontological writings is added.

The book is a mine of skillfully assembled information on a critical period in the emergence of ideas on organic evolution.

August 14, 1933. CHARLES A. KOFOID.

Charles Darwin's *Diary of the Voyage of H. M. S. " Beagle."* Edited from the MS. by NORA BARLOW. XXXI+451 p., 2 pls., 2 folded maps, and portrait frontispiece. Cambridge, England, at The University Press; New York, The Macmillan Company, 1933. Price $6.50.

The granddaughter of the originator of the theory of natural selection has edited his diary written aboard the surveying ship H. M. S. " Beagle " in 1831-1836 during the memorable circumnavigation of the globe by that vessel and her companion, the " Adventure." Their task was the surveying of the storm-swept coasts of South America from Rio de Janeiro around the Horn to Callao for the Hydrographic Department of the British Admiralty. The work was well done, as evidenced by the 82 coastal sheets, 80 plans of harbors, and 40 views. This was carried out under the direction of Captain ROBERT FITZROY, a descendant of CHARLES II, an irascible, hot-tempered martinet, but with fine qualities of determination and indomitable energy greatly admired by the youthful and as yet wholly untried naturalist. CHARLES DARWIN was placed on the ship's books to " collect useful information " at the early age of 22. HENSLOW, the botanist at Cambridge University, who had at first thought of accepting the post, was responsible for the offer being made to his favorite pupil, but the cautious father of CHARLES DARWIN was loath to see his son abandon his plans for becoming a clergyman. JOSIAH WEDGWOOD, CHARLES DARWIN's uncle and later his father-in-law, overcame these scruples by his shrewd estimate of the young man and

of this opportunity opened before him: "Looking upon him as a man of enlarged curiosity, it affords him such an opportunity of seeing men and things as happens to few."

The diary consists of eighteen little pocket books with pencilled records of the casual details of the day's work. Its contents fill the 431 pages of the present book. The transcription is made with scrupulous fidelity to the original, with all the misspellings, e.g. "Portugeese," redundancies, misuse of capitals, and elisions as DARWIN jotted them down. All words added for clarification are suitably bracketed. Explanatory additions, even in footnotes based on DARWIN's marginal notes, are few.

The editor's annotations are appended to the text of the diary and include extracts from as yet unpublished letters to the family and pertinent excerpts from FITZROY's "Narrative." The diary does not record DARWIN's maturer scientific thinking. This was incorporated in his more methodical notebooks.

The diary was the basis of the *Narrative of the Surveying Voyages of His Majesty's Ships Adventure and Beagle* (1839), which formed Volume III of FITZROY and KING's *Voyages of His Majesty's Ships Adventure and Beagle* published in three volumes with an appendix to Volume II. A second issue of this first edition of DARWIN's volume was published in 1839. It was occasioned by the greater demand for DARWIN's volume than for the others. In this the new title page reads *Journal of Researches into the Geology and Natural History of the various Countries visited by H. M. S. Beagle.*

At this period of DARWIN's life geology loomed larger in his thought than natural history. In the title of the later editions of the *Journal* this order was reversed and "Natural History" appears first in the title. A third issue of the first edition appeared in 1840; a German translation by DIEFFENBACH, with notes by the translator, appeared in 1844; and a second edition, published by his later and lifelong publisher, JOHN MURRAY, appeared in 1845. In this edition the *Journal* was revised, somewhat condensed, and the maps were excluded. A "new edition," with "10 thousand" added, appeared in 1860, and another one in 1870, but it was not until 1890 that MURRAY relented and included the maps.

Some fragments of the diary included in DARWIN's letters to HENSLOW were privately published by the latter in a 32-page pamphlet, now exceedingly rare, in a small edition for distribution to members of the Cambridge Philosophical Society in 1835.

The manuscript diary is considerably shorter than either the first or the second edition of the *Journal*. The manuscript contains about 189.000 words, the first edition 224.000, and the second 213.000. The scientific discussions added in the published *Journal* were drawn in large

part from the classified material on geological, ornithological, and other subjects kept in DARWIN's separate notebooks. These discussions exceed in length the hitherto unpublished part of the diary. The diary's daily record of first impressions has less of scientific value than the maturer *Journal*. Its significance lies in the fact that it contains the history of CHARLES DARWIN's apprenticeship to science. The editor comments upon the increasing attention, as the five years of the voyage passed, given by the diarist to geological matters and to the elaboration of scientific subject matter.

When DARWIN left England in 1831 he was a creationist holding to the immutability of species, according to the editor of the diary. He took with him on the voyage the first volume of LYELL's *Geology*, and the second reached him in South America. By the autumn of 1835 his geological observations had opened his mind to the succession of life in geological time, and his contacts with the fauna of the Galapagos Archipelago had revealed the significance of the geographical distribution of species. In 1837 the diary records : " In July opened first note-Book on ' Transmutation of Species.'—Had been greatly struck from about month of previous March on character of S. American fossils—& species on Galapagos Archipelago.—These facts origin (especially latter) of all my views." In March he had recorded in the diary the effects of crustal movements upon past faunas on the coasts of Argentine. It is also evident in the last months of the voyage that he was accumulating material with a view to its significance. The diary is suggestive of these changing views only in the nature of the facts recorded. It does not contain any formulation of evolutionary views.

DARWIN in his autobiography acknowledged that the voyage was by far the most important event of his life and that it had determined his whole career. He recognized that it had developed in him the habit of energetic industry and the power of concentrated attention, which later in his scientific career enabled him to accomplish his life work. His love of science gradually came to supersede his love of sport. The pleasure in observing and reasoning upon his observations gradually during this memorable voyage grew to such proportions as to shape his future.

The diary is supplemented by the editor with biographical notes on the *dramatis personae* of the voyage, a tabulation of sections of the diary not included in either the first or second edition of the *Journal*, of those omitted in the second edition, and a list of passages and subjects found in the *Journal* (Ed. 2) not occurring in the diary. The maps are a Mercator with the route of the voyage, and a detailed one with the routes of the inland expeditions in South America.

The frontispiece is an unpublished portrait of DARWIN as a young man, based on a drawing found by Professor SEWARD in a portfolio of DARWIN relics in the cellar of the Cambridge Botany School in 1929. It is almost identical with GEORGE RICHMOND's watercolor of 1840 and may have been a preliminary sketch for that portrait made four years after the return of the " Beagle." It is by far the most attractive portrait among all those published. It portrays in a peculiarly suggestive manner the thoughtful determination which the voyage of the " Beagle " had wrought into the intellectual character of this developing interpreter of the world of life.

December 1, 1933. CHARLES A. KOFOID.

Memorial Lectures Delivered Before the Chemical Society, 1914-1932. Vol. III. The Chemical Society, Burlington House, Picadilly, London, W. 1., 1933. 180 pages. Price 6 shillings, postage 6 pence extra.

The Memorial Lectures of the Chemical Society constitute a valuable collection of material on the history of modern chemistry. Each lecture gives an account of the life and scientific work of a distinguished Foreign Honorary Member of the Chemical Society, and each has been prepared by an author qualified by his own researches to estimate the significance of the work of the chemist whom he is discussing. Volume I, 1893-1900, contains twelve lectures ; Volume II, 1901-1913, thirteen ; and the present Volume III seven lectures—on EMIL FISCHER by Sir M. O. FORSTER, on ADOLF VON BAEYER by W. H. PERKIN, on JOHANNES DIDERIK VAN DER WAALS by Sir J. H. JEANS, on HEIKE KAMMERLINGH ONNES by ERNST COHEN, on SVANTE AUGUST ARRHENIUS by Sir JAMES WALKER, on THEODORE WILLIAM RICHARDS by Sir HAROLD HARTLEY, and on OTTO WALLACH by LEOPOLD RUZICKA.

FISCHER, BAEYER, and WALLACH were three great builders of the science of synthetic and structural organic chemistry. FISCHER elucidated the structure of carbohydrates, glucosides, etc., purine derivatives, polypeptides and proteins, and made important contributions to technology and the knowledge of enzymes. BAEYER is popularly known for his synthesis of indigo. He studied many of the more puzzling phenomena of organic chemistry and evolved many hypotheses which have led, and are still leading, to fruitful experiments. WALLACH set the terpenes in order. The other four men were physical chemists. ARRHENIUS proposed what he himself considered a " chemical theory of electrolytes," but it proved to be, as Sir OLIVER LODGE called it, an " electrolytic theory of chemistry." The name of VAN DER WAALS is attached to an improved form of the gas law which contains terms

corresponding to the physical properties of the molecules. RICHARDS determined the relative weights of the atoms with unsurpassed precision. He speculated on the volumes and compressibilities of atoms, on the forces within and between molecules, in a manner which has opened new and still-to-be-explored fields in our knowledge of the constitution of matter. KAMMERLINGH ONNES liquefied helium and attained the lowest temperatures yet reached by man. Altogether, the present book refers to a considerable proportion of the important events in the history of chemistry during the latter half of the nineteenth and the first quarter of the twentieth century. TENNEY L. DAVIS.

Michael Faraday.—*Faraday's diary*. Being the various philosophical notes of experimental investigation made by MICHAEL FARADAY during the years 1820-1862 and bequeathed by him to the Royal Institution of Great Britain. Now, by order of the Managers, printed and published for the first time, under the editorial supervision of THOMAS MARTIN. Foreword by Sir WILLIAM H. BRAGG. Vol. III, May 26, 1836-Nov. 9, 1839, XII+466 p., 2 pl.; vol. IV, Nov. 12, 1839-June 26, 1847, XII+448 p., 2 pl. London, BELL, 1933 (to be completed in seven vols., only 150 sets costing £12.12.0 each).

We published a long review of vols. I and II of this fundamental publication in *Isis*, 20, 472-4, and a briefer account of these new volumes will suffiice.

Vol. III deals with the period May 26, 1836-Nov. 9, 1839. It contains such items as these: Discussion of POISSON's theory. Experiments with a COULOMB torsion electrometer. Determination of specific inductive capacities (plate 2 represents the apparatus of metallic spheres used by FARADAY for that purpose). Differential inductometer. Magnetic properties of metals and metallic compounds at low temperatures. (May 17, 1838). Induction through crystalline bodies. Inductive capacities measured parallel to and transverse to the crystalline axis; an apparent difference found in rock crystal. Experiments with the Gymnotus at the Adelaide Gallery; the shock from the fish; a galvanometer deflected and chemical action produced by the current. (Sept. 3, Oct. 5). Observations of aurora borealis at Brighton. Experiments with the Gymnotus continued. In 1839, Faraday made a series of important experiments on voltaic electricity which furnished the substance of the sixteenth series of his *Experimental researches* (vol. 2).

Vol. IV covers the period Nov. 12, 1839 to June 26, 1847. Continuation of voltaic experiments. Electro-magnetic induction: theory of induction, the electrotonic state. (No entry from Sept. 14, 1840 to June 1,

1842 ; nor from Feb. 16, 1843 to Feb. 12, 1844). In 1844, many notes on the liquefaction of gases. In 1844-45, FARADAY continues the study of liquefaction and solubility of gases and begins his investigations on the interdependence of light, electricity and magnetism. On Sept. 13, 1845, he succeeds in establishing the action of magnetism on a polarized ray of light. In Nov. of the same year by means of a powerful electro-magnet (pl. 1) he measures the magnetic rotation of polarized light in various substances. The volume ends with a note of June 26, 1847, recording an interview with HAMILTON in Oxford.

" Sir WILLIAM HAMILTON and self talked over the relations of two electric currents at right angles to each other, when, according to AMPÈRE, they have no mutual action. I have expected some effect between them analogous to that state of magnetism which must be the equivalent of static electric induction, but could never discover any : Sir WILLIAM HAMILTON, I find, expects an effect on mathematical principles. Must try again in various ways."

G. SARTON.

Karl Pearson. —*The life, letters and labours of Francis Galton.* Volume III A : Correlation, personal identification and eugenics. Volume III B : Characterisation, especially by letters. Index. XII+673 p., 63 pl. Cambridge, University Press, 1930.

Vol. I and II (1914-24) of this very important work were reviewed in *Isis* (vol. 8, 181-8). Our review of vol. III was delayed by the negligence of the publishers. These three volumes admirably illustrated constitute probably the largest collection of materials relative to a modern man of science ever published by a single author. The whole is less a biography in the conventional sense, than a biographical commentary on a man's life-long activity. The size of this monument is justified by the following remarks (p. vi) :

" The dominant race of the future, the leading nation of civilisation, will not be the one with the greatest material resources, nay, not even the one with the greatest wealth of tradition; it will be the one which can claim to have the finest breed of men and women, physically and mentally. Civilisation has gained nothing from rivalry in destructive warfare; it can gain enormously from the rivalry of nations in rearing their future generations from the most efficient of their citizens. GALTON was the first to realise this great truth, to preach it as a moral code, and to lay the foundations of the new science which it demands of man. In the centuries to come, when the principles of Eugenics shall be commonplaces of social conduct and of politics, men, whatever their race, will desire to know all that is knowable about one of the greatest, perhaps the greatest scientist of the nineteenth century."

Vol. III A contains three parts : Ch. XIV : Correlation and the application of statistics to the problems of heredity. Ch. XV : Personal identification and description (i.e. finger-prints). Ch. XVI : Eugenics

as a creed and the last decade of GALTON's life. Vol. III B is chiefly a collection of letters and other documents covering the whole of GALTON's life.

A detailed review of this work is out of the question but I noted down the following points while reading it.

The conception of correlation " in biometric data as apart from the idea of regression in heredity which GALTON had reached some years earlier, without perceiving at once its capacity for wide generalisation in the treatment of associated variates in all living forms," (p. 50) was first expressed in a paper sent to the Royal Society on Dec. 5, 1888 and read fifteen days later " Co-relations in their measurement chiefly from anthropometric data."

Says PEARSON " Like so much of GALTON's work the present paper reaches results of singular importance by very simple methods; his methods are indeed so simple that we might almost believe they must lead to a fallacy had not GALTON deduced thereby the correct answer."

And further (p. 57) " The ideas on heredity and correlation which had been working in GALTON's mind during the decade of the eighties found final expression in his book entitled *Natural Inheritance*, published in 1889 when GALTON was 67 years of age. It may be said that this publication created GALTON's school; it induced WELDON, EDGEWORTH and the present biographer to study correlation and in doing so to see its immense importance for many fields of inquiry. It is idle to overlook the haste with which it was prepared and the many slips and positive errors to be found in its pages, but no one who studied it on its appearance and had a receptive and sufficiently trained mathematical mind could deny its great suggestiveness, or be other than grateful for all the new ideas and possible problems which it provided."

The pages on " Eugenics as a religious faith " (p. 87-93) are very interesting; they complete similar ideas already set forth in the earlier volumes (see my review, *Isis*, 8, 186).

The foundation of *Biometrika* (1901) was partly caused by the objections of the Royal Society to biometric subjects " Bíos was an admissible topic, métron also, but their combination was anathema." That hostility was largely due to WILLIAM BATESON (see p. 100, 282 and by index). It is strange, and a little pitiful, that such a rivalry should have arisen between the Mendelians and the Galtonians.

The idea of the continuity of the germ-plasm, generally attributed to AUGUST WEISMANN had previously occurred to GALTON. See on p. 340-41 (1) a letter from WEISMANN to GALTON (Freiburg i. Br., 23 feb. 1889) acknowledging this, but not without qualification : " You have exposed in your paper an idea which is in one essential point nearly

(1) See also same work (vol. 2, 81-2, 169-71, 186-7.

allied to the main idea contained in my theory of the continuity of germplasm."

The existence of the " Eugenics Education Society " was often a source of trouble to the Eugenics Laboratory, because its members had no understanding of scientific needs and methods, and like all other proselytes loved their " religion " more than truth (see p. 407 and by index).

This suggests the fundamental difficulty of every moral or religious movement based on scientific knowledge : it can hardly gain in popular strength without losing in scientific rigor. Pure ideas make no appeal to the people : their persuasiveness always implies an adulteration; their triumph cannot but be a result of misunderstandings. Is there then no hope of intellectual progress? Yes there is,—but the progress is exceedingly slow—a long series of successive approximations which may be interrupted by catastrophic backslidings. Happily there are always some men, very few, who love truth for its own sake and who do not need any outside encouragement to forge ahead in the right direction. It is because of the existence of such men that mankind progresses—however slowly it be—and that no catastrophy can stop its advance very long. Hence the best way of insuring human progress is to increase the number of such men and to facilitate their task. This problem is easier to formulate than to solve. I was already deeply influenced by GALTON when I started *Isis* in 1912 and began the publication in the second number (1913) of " *Etudes de géniologie* " and of my (unfinished) memoir on *Comment augmenter le rendement intellectuel de l'humanité*. I have not ceased to think on the subject ever since : my aim remains the same but I am more conscious of the innumerable difficulties to be overcome.

Considering the extreme brevity of our life and the infinite distance of our goal—our speed is of little importance, but we should always try to walk in the right direction. GEORGE SARTON.

H. W. Dickinson and **Arthur Titley.**—RICHARD TREVITHICK (1771-1833), *the engineer and the man*. Trevithick Centenary Commemoration Memorial Volume. XVII+290 p., 18 pls., 41 figs. in text. Cambridge, University Press, 1934. $5.00.

A biography of this famous engineer by his son FRANCIS was published in 1872. The present work is a critical revaluation and consecutive story of his life showing under what influences of events and men his inventions were conceived; upon what soil, fertile or barren, the products of his prolific brain fell; what was the immediate, and what the abiding outcome of his inventions. New matter is added giving a balanced presentation of his fascinating personality and of his varied career reviewed

in the light of the state of the arts and economic conditions of his times. The modern organization of knowledge in encyclopedias, specific histories, indices, and bibliographies, has so foreshortened the interval between the birth of an idea and its application that the slow development, over two milleniums, of the engine seems astounding. HERON (3rd Century B.C.) applied steam on the principle of the reaction turbine; BRANCA (17th Century) used it in a toy as the impulse turbine; SOMERSET (1663) exploded a closed cannon by its use; SAVERY raised water by the condensation of steam; NEWCOMEN (17th Century) made the first practical atmospheric engine, and JAMES WATT (18th Century) perfected the low-pressure condensing engine. The high-pressure engine and its applications intrigued the inventive mind and versatile talents of RICHARD TREVITHICK (1771-1833). Among his many ideas, towards the realization of which his inventions were directed, are the high-pressure boiler and engine, their application in stationary engines to pumping, dewatering mines in Cornwall and in South America in the high Andes, dredging, and to drainage problems in the Netherlands. The use of locomotive engines early engaged his attention resulting in 1801 in his steam road carriage, in 1804 in the tramway locomotive, in 1805 in the railway locomotive and the canal barge with paddle wheels, in 1808 in the passenger locomotive, in 1812 in the screw propeller. He also devised the reeling engine for mines, stream driven fire ships, iron tanks for cargo storage, floating docks, iron ships and masts, iron buoys, steam drills for rock boring, steam heaters and cookers, and various devices for the perfection of the compound high-pressure engine. He combined the qualities of the practical engineer with the tireless enthusiasm of the visionary, and had at the same time a simplicity and directness of analytical power. His endocrine system functioned magnificently and his genetic endowment may be traced through four generations. (See *Isis*, 20, 445-7).

CHARLES A. KOFOID.

Otto Glasser.—WILHELM CONRAD RÖNTGEN and the early history of the roentgen rays. With a chapter "Personal reminiscences of W. C. RÖNTGEN" by MARGRET BOVERI. XII+494 p., 96 fig. Springfield, Ill., THOMAS, 1934. ($6).

The author of this book, who is a biophysicist and head of the department of radiation research in the Cleveland Clinic, Cleveland, Ohio, published it first in German, when it constituted the third volume of the series *Röntgenkunde in Einzeldarstellungen* (Berlin, 1931; *Isis*, 18, 366). This English translation prepared under his own direction is very welcome.

The following paragraph culled from the preface is so good a summary that I reproduce it verbatim:

" Unusual experiences at school during his early youth caused the alert young WILHELM RÖNTGEN to seek education in his own way. His was not the usual path leading to the German professorship, yet the year 1875 found RÖNTGEN, then 30 years old, the Professor of mathematics and physics at the College of Agriculture in Hohenheim. Twenty years later, on November 8, 1895, RÖNTGEN, the then well-known scientist and professor of physics at the Univeristy of Würzburg, saw the effect of a strange and unusual phenomenon while doing some experiments in his laboratory. He pursued the study of this effect in a most masterly and thorough manner, and discovered it to be due to ' a new kind of rays.' On December 28, 1895, after seven weeks of most arduous labour, he presented to the president of the Physical Medical Society of Würzburg his first written report on the discovery, the classical ' Preliminary communication.' This report was accepted for publication in the Annals of the Society although it had not been read before a meeting. A few days later the news of the sensational discovery was printed in the German Newspapers, and on January 6 it was cabled from London to all the world. Everywhere scientists and laymen hastened to explore the magic unknown realm which RÖNTGEN had exposed to the light of knowledge. An immense amount of work with the new rays was begun. The news of the rays had already reached the last outposts of human culture when their modest discoverer spoke publicly on his discovery for the first time on January 23, 1896, before the Physical Medical Society of the University of Würzburg. After this lecture the famous anatomist, VON KOELLIKER, christened the new scientific wonder as ' RÖNTGEN's rays.' "

This startling discovery was the prelude to various others which revolutionized physics so completely that history of modern physics might well be made to begin in that year 1896. The announcement of it was received with the utmost eagerness all over the world, and ROENTGEN's first publication *Eine neue Art von Strahlung* was promptly followed by an endless series of others by scientists of every civilized country. This illustrates the astounding speed of scientific diffusion in our time and the acceleration of scientific progress. In the Middle Ages the news of a discovery could not spread very fast, because not only were regular channels of communication nonexistent, but various physical and spiritual obstacles impeded the transmission of news and sometimes stopped it altogether. In the seventeenth century the transmission was accelerated first by semi-professional news-distributors such as Father MERSENNE, later by the creation of academies and their journals. The speed increased continually. OERSTED's discovery of electromagnetism in April 1820 was known within the year all over Europe. Three quarters of a century later, the speed was such that the X-rays were known all over the world within a few weeks, and it was possible to repeat and continue ROENTGEN's experiments in almost every physical laboratory. This was facilitated by the circumstance that HITTORF-CROOKES tubes and large induction coils were already available everywhere, and those who manufactured them were able to produce more and better ones

as soon as the new demand was felt. According to the bibliography appended to GLASSER's book, there appeared within that single first year 1895, 49 books and pamphlets and 1044 papers on X-rays ! (see p. 422-79).

ROENTGEN's fame in 1896 and later was so great that it excited some jealousy, and the time anterior to the memorable Friday (Nov. 8, 1895) night when he observed the fluorescence of barium platino-cyanide crystals, was made to appear by contrast less brilliant and fertile than it really was. ROENTGEN's discovery was not an undeserved piece of luck, but the climax of a very distinguished scientific activity extending over more than twenty-five years. He had obtained his Ph. D. in Zurich in 1869 and from that time on to the end of the century and even to 1921 he conducted a large number of careful experiments in many directions : determination of the ratio of the specific heats of gases, discharge of electricity under various conditions, conductivity of heat in crystals, pyro- and piezo-electricity, theory of elasticity and capillarity, electromagnetic rotation of the plane of polarization of light in gases, KERR effect, absorption of heat in water vapour, viscosity and compressibility of liquids, influence of pressure upon the dielectric constants, etc. In 1886, together with SCHNEIDER he proved that the compression coefficient of solutions is smaller than that of water, and decreases generally when the concentration increases (*Ann. Physik. u. Chem.*, N. F. 29 : 165).

" In 1888, he made his famous investigations to prove that magnetic effects are produced in a dielectric, such as a glass plate when it is moved between two electrically charged condenser plates. This work is one of his most important investigations based upon the theoretical reasoning of the FARADAY-MAXWELL electro-magnetic theory. The results which he obtained were the ideal co-ordination of the functions of a theorist and those of a genius in experiment. It was because of the value of the connection between the theoretical conception of the problem and its experimental proof that RÖNTGEN himself regarded this ' ROENTGEN current, ' so named by H. A. LORENTZ, as being of as much importance as his discovery of the ROENTGEN rays. SOMMERFELD stated, ' The ROENTGEN current, together with the ROWLAND effect, forms an indispensable foundation for the conception that the dielectric properties of matter depend upon the presence of charges (electrons) and, in its later quantitative perfection, it decides directly against the original MAXWELL-HERTZ theory.' " (p. 83). " From the abnormal action of water as compared with other liquids, that is, its decrease of compressibility with increasing temperature, and decrease of internal friction through pressure, or through the increase of the thermal coefficient of expansion with pressure, he concluded that water consists of two types of molecules. These two types are : first, the ice molecules which cause a larger volume, and a second kind of molecules which are formed if the temperature increases and which cause a decrease in volume." (p. 85.)

ROENTGEN continued to investigate, the properties of crystals until

the end of his active life. It is interesting to compare his reaction to MAX VON LAUE's discovery of the interference of X-rays (1912; see *Isis*, 5, 526) with BIOT's reaction to PASTEUR's discovery of the true nature of the paratartaric acid in 1848: both men reacted in the same way, with characteristic scientific scepticism.

"The famous experiments made at the suggestion of M. VON LAUE by W. FRIEDRICH and P. KNIPPING on the roentgen ray interferences in crystals commanded RÖNTGEN's greatest respect and interest. Upon hearing about these experiments he went at once to SOMMERFELD's institute where these beautiful pictures had been made for the first time, and his interest was extraordinary 'I still can see RÖNTGEN as he carefully studied these pictures in my laboratory' said SOMMERFELD later. FRIEDRICH showed him the pictures and the apparatus, and after RÖNTGEN had studied them thoroughly and critically, he declared that he could find no experimental error. RÖNTGEN then sincerely congratulated FRIEDRICH on his important experimental results but he added, 'I do not think that these are interference phenomena. They look different to me.' However, soon thereafter, he became convinced of the fact that these pictures actually represented the result of interferences of roentgen rays especially after E. WAGNER and R. GLOCKER had made their investigations on the monochromatic character of the diffracted rays in his own institute and after the publication of the famous experiments of W. H. and W. L. BRAGG in England." (p. 80.)

The best part of this work was written by RÖNTGEN's young friend MARGRET BOVERI of Berlin, the daughter of the well known cytologist, THEODOR BOVERI (1862-1915). That part entitled "Personal reminiscences" (p. 118-198) is a complete biography in itself; it even includes a full list of RÖNTGEN's scientific papers. What is more important is the fact that it reveals the character of a good man, whose goodness was not impaired by his fame. To Fräulein BOVERI's biography, GLASSER has added an abundance of information on every aspect of the master's activities and their repercussions. In fact as the title indicates, this is not simply the biography of a great pioneer, but the early history of an important branch of physics. GEORGE SARTON.

Cattell, J. McKeen and **Cattell, Jaques.**—*American men of science.* Ed. 5., VIII+1278 p. New York, The Science Press, 1933. (Price $12.00 net.)

The latest edition of this exceedingly useful biographical dictionary is the fifth to appear under the editorship of one of America's leading investigators of human behavior. The broad lines along which the enterprise was conceived and has been carried out are best illustrated in this latest edition in which the analytical comparisons are enriched by the contributions of the passing years.

The work includes all five prefaces, the first a prolegomenon of the

enterprise, and the later ones indicative of its developments and modifications. The biographical dictionary of about 22.000 names forms the body of the work. The biographical dictionary is designated as "American," but is mainly North American. The representation from Latin America is small.

The distribution of the 12.877 names of the fourth edition (1927) is shown below:

TABLE I

Mathematics	756
Physics	991
Chemistry	2.561
Astronomy	239
Geology and Geography	903
Zoology	1.435
Botanical Sciences	1.187
Anthropology	111
Psychology	539
Social and Economic Sciences	23
Historical and Philological Sciences	37
Engineering	1.245
Medical Sciences	2.027
Agriculture	769
Education	54

The distribution of 9.785 of the names of Table I, which may be allocated to the twelve fundamental sciences, appears in Table II:

	ALL	WOMEN	PER CENT. WOMEN
Mathematics	756	61	8.0
Physics	991	28	2.1
Chemistry	2.561	117	4.6
Astronomy	239	23	9.6
Geology	903	32	3.5
Botany	1.187	119	10.0
Zoology	1.436	130	9.0
Physiology	460	48	10.4
Anatomy	206	11	5.4
Pathology	396	28	7.1
Anthropology	111	11	9.9
Psychology	539	117	22.0

The percentage of women in these sciences ranges from 2.1 % in physics to 22 % in psychology, 10.4 % in physiology, and 10 % in botany. This distribution reflects the large numbers of women in teaching and clinical positions, and probably also sociological and aesthetic

motivations. The dictionary is followed by an alphabetical list of 869 men of science who died since the fourth edition of 1927, with a statement of their fields of interest and the years of birth and death.

As in all earlier editions the editor has continued by the objective method of competitive selection by colleagues, the designation of the first thousand scientists eminent in their respective fields. The fifth edition adds 250 names to the earlier lists of men thus selected. The editors discuss the distribution of these selected men and list them alphabetically in sequence of eminence determined by votes received.

The age distribution of the last 250 added to the list indicates that eminence is attained earlier among physicists (36 years) and mathematicians (36.1) than among the natural scientists, such as the psychologists (44), zoologists (45.3), botanists (47), and geologists (49.4).

An analysis of the birthplace and residence of the 1.000 selected scientists for the four periods, 1903, 1910, 1921-27, and 1932, shows certain shiftings both in the sources and ultimate locations of scientific men in the United States. In general these are the results of the westward migration followed by the rise of education and culture in the North Central States and in California. They reflect also the slower progress in the Southern and Southeastern states. Foreign contributions have come from Canada, England, Germany, Russia, Scotland, Sweden, Japan, Switzerland, and Holland, in the main. The distribution by degree-granting institutions and by institutions with which the scientists are now associated is also tabulated.

A study of the distribution of scientific men among the several sciences at successive periods, and in different nations, affords a quantitative basis for the study of the history of scientific movements in relation to other human activities. Since 1903 there has been a marked secular rise in the relative number of scientific men, specifically from about 4.000 in 1903 to 22.000 in 1933 in this American list. A significant number of sons of scientific men have attained high standing in the last twenty years and an increasing proportion of scientific men marry women engaged in scientific work.

December 1, 1933. CHARLES A. KOFOID.

Dom J. Jeannin.—*Études sur le Rythme Grégorien*, 284 p., ETIENNE GLOPPE, Lyon, 1925 (20 francs).— *Rythme Grégorien*, Réponse à Dom MOCQUEREAU, 144 p., ETIENNE GLOPPE, Lyon, 1927 (16 francs.)

As a member of the Benedictine order which has done so much for scholarship and art, Dom JEANNIN published a learned study of Syrian and Chaldean Liturgical Melodies, (1) in 1925. In this work he set

(1) Mélodies liturgiques Syriennes et Chaldéennes, par DOM JEANNIN, Moine

forth his conclusions, first that Western European church music has been influenced by the music of the near East, second that the Syrian church, even in remotely separated regions, has preserved the same melodies and a single system of measured time. In the light of these findings, he returned to Gregorian music, as studied, taught and practiced at Solesmes. As he looked at the manuscripts with a fresh eye, as he listened to the Benedictines' singing, so to speak, with a fresh ear, he questioned much that he had unquestioningly accepted before. The results of his questioning are before us in two more books, his " Études sur le Rhythme Grégorien " (1925) and his " Rhythme Grégorien, Réponse à Dom MOCQUEREAU " (1927). Let us glance at that musical phenomenon, Solesmes, and compare it with Dom JEANNIN's pronouncements.

Almost all of us who have paid the least attention to Gregorian music have been deeply influenced by the Benedictines of Solesmes. Their publications of ancient manuscripts, in the *Paléographie Musicale*, are the admiration and the resource of scholars; their modernized editions of Gregorian music, approved by Rome, have supplanted all others; their singing has attracted not only the devout but even alien connoisseurs to their monastery; phonographic records have carried their exquisite interpretations far and wide to the students and musicians who could not make the pilgrimage there. A pilgrimage it is indeed. For at Solesmes, Gregorian music, as Dom MOCQUEREAU has beautifully defined it, is prayer; under his guidance, the singing of the monks' choir is aerial, almost supernatural. As the monks wrote : " the flight of a bird, leaning on the air at each wing stroke; the bird's alighting; a light snow-flake falling slowly, touching the ground and vanishing," these things " approach... the delicacy of musical rhythm." (The rhythm of Gregorian music as sung at Solesmes). But in these things, they go on, " something material,... still remains." These monks' voices are " lighter, more subtile than a snow-flake." (2)

This lightness of execution, with its avoidance of the downward beat at the beginning of a phrase, and its freedom from all trammels of measure, is a revelation. It is amazing. One is tempted to say, it is the last word in musical rhythm—what the most modern musicians might be groping for, as the ultimate expression of delicacy and of freedom in musical art. Is it possible that monks of those ninth and tenth centuries sang with such subtle sophistication? If so, we must revise our notions of civilization in those days.

Benedictin, 3 volumes. I. Introduction Musicale, 305 p., 80 francs. II. Mélodies Syriennes, 709 p., 120 francs. III. Not yet published? LEROUX, Paris, 1924, 1930.

(2) Paléographie Musicale, VII, 181.

What are the facts? Dom JEANNIN, who looks at history with less idealization perhaps than Dom MOCQUEREAU, reminds us of what contemporary writers had to say, for instance, about rhythm and about beating time. HUCBALD (3) in the ninth century wrote that singing masters, in teaching their pupils, should " inter cantandum aliqua pedum manuumve vel qualibet alia percussione numerum intruere." AMILAIRE DE METZ in the same century devoted a chapter to the liturgical castagnettes of bone, used for beating time. " Cantor tenet tabulas [castagnettes] in manibus," he said, " tabulae quas cantor tenet, solent fieri de osse." (4) Cymbals, like castagnettes, also emphasized the time; for, as AELRED (5) wrote (about 1109-1166), " in Ecclesia tot organa, tot cymbala... stans interea vulgus sonitum follium, crepitum cymbalorum, harmonium fistularum [organ pipes?] tremens attonitusque miratur." Nor was the sound of cymbals exceptional in monastic churches; for the monk THEOPHILUS, in his famous manual of the arts, describes just how they were cast.

So much for marking time. What, now, of exact measure? ALCUIN (6) in the eighth century wrote that rhythm was fixed by " feet and numbers ".

Utque souos dulces decantent voce sonora,
Quos pedibus, numeris, rhythmo stat musica, descant.

HUCBALD (7) said " Veluti metricis pedibus [metric feet] cantilena plaudatur." REMI D'AUXERRE (8) in the tenth century repeated " quasi metricis pedibus cantilena plaudatur." Moreover he wrote of two types of neume " quibus constant brevia et longa... secut unum ad unum vel duo ad duo," i.e., equal to single notes and double notes. GUY D'ARREZZO (9) added " Aliae voces ab aliis morulum duplo longiorem, vel duplo breviorem habeant "; " Notes are distinguished one from another, the longs by double length [being twice as long as a short note], the short by double shortness [being twice as short as a long note]." Or as HUCBALD (10) had already put it: " Omnia longa aequaliter longa, brevium sit par brevitas."

These are a few of the many quotations by which Dom JEANNIN supports his statement that, wonderful as the singing at Solesmes may be, such freedom of rhythm was unknown to musical theorists in the

(3) Rythme, 59.
(4) Études, 151.
(5) Études, 153.
(6) Rythme, 17.
(7) Rythme, 30.
(8) Rythme, 25, 13.
(9) Rythme, 94.
(10) Rythme, 126.

days when this music was written. And THÉODORE GÉROLD, (11) an authority quite aloof from Dom JEANNIN's controversy with Solesmes writes that, " if the authority of mediaeval texts were completely recognized, the execution of Gregorian melodies, as practiced and taught by the Benedictines, could scarcely be defended."

Dom JEANNIN is far from resting his case on the testimony of mediaeval theorists. He uses their statements for the light which they may throw on musical texts. Of these, as Dom MOCQUEREAU (12) says, there are two classes, first the purely melodic manuscripts which throw no light on questions of rhythm or of measured time, second the manuscripts whose neumes are supplemented by indications of rhythm. These indications, on the whole, consist of a line called an episeme, and the three letters, *c*, *m*, and *t*.

Thus far Dom MOCQUEREAU and Dom JEANNIN are in agreement. But here their paths diverge. Dom MOCQUEREAU is committed to his thesis that these rhythmic signs indicate delicate *nuances*, slight acceleration of one note, faint prolongation of another. Dom JEANNIN, by comparing contemporary authorities with musical texts, and by studying parallel texts of a single melody, reaches quite opposite conclusions. For him, (13) the letters *c* and *m* were used merely as reminders that a short note, which might be mistaken for a long note, was indeed short; an episeme or the letter *t* on the other hand always indicated a long note. A short note was the unit of measure, and was never shortened; a long note was always equal to two shorts. Here in brief is the essence of a system of measure.

In its application, the system is far less simple. Since the musical texts served, not for sight reading, but merely to remind the singers of melodies learned by heart, the indications of time in any one manuscript are incomplete. Only by comparing many manuscript versions of any one melody can all its long notes and all its short notes (and pairs of notes) be identified.

The results of such comparisons are often striking, as for instance where Dom JEANNIN compares three Solesmes versions of one melody in three inconsistent, free rhythms, with three consistent versions of the same melody in measured 3/8 and 4/8 time. (14) These versions may seem mechanical; " arithmetical " Dom MOCQUEREAU calls them. The criticism is hardly to the point. The question after all is not wholly

(11) THÉODORE GÉROLD, La Musique au Moyen Age, 19-20, CHAMPION, Paris, 1932, 454 p. 60 francs.

(12) *Revue Grégorienne*, sept.-oct., 1925.

(13) Rythme, 35-36.

(14) Rythme, 118.

one of taste. It is a question of historic fact. Was Gregorian and Ambrosian music in the early Middle Ages actually sung in free rhythm with delicate *nuances*, or was it sung as measured music?

Whatever the final verdict on Dom JEANNIN's studies may be, the Solesmes versions of certain famous melodies may give us pause. "Let us bless Solesmes," says Dom JEANNIN, (15) "for having put in our hands, with its reproduction of manuscripts, concrete proof that there is a difference between our (the Benedictines') execution (of these pieces) and that of the middle ages. Manuscript 359 of Saint Gall is alone enough to show any one who takes the trouble to look at it, that the Crux Fidelis in the good period, with its numerous long notes, had a far different movement from the Solesmes Crux fidelis, which is nothing but a dilution in rose water." This seems severe. Yet a devoted partisan of Solesmes has told the present writer, in tones of praise, that the Dies Irae as sung by the Benedictines sounds like a "lullaby." Surely some of the great hymns of the church were sung more vigorously and in more definite meter. As WALEFRID STRABUS (16) wrote, about 840, "Hymni metrici et ritmici in Ambrosionis officiis dicuntur." And SAINT AUGUSTINE (17) remembered the twelve-time, "tempora duodecima," of the Ambrosian Deus Creator omnium "in sona qui auditor, in sensu audientis, in actu pronunciatis, in anima nostra." As for Gregorian pieces of the ninth, tenth, and eleventh centuries, we may well ponder Dom JEANNIN's remark (18) that, in history, Gregorian music "stands not alone, but closely surrounded by three other musical facts, Greco-Latin, oriental Judeo-Christian [music], and in later times the mediaeval cantus mensurabilis; certainly all three included measure." Does it seem likely that Gregorian music should alone have escaped the chains of measured time?

(Cambridge, Mass.) HENRY COPLEY GREENE.

John Webster Spargo.—VIRGIL *the necromancer, studies in Virgilian legends*, 502 pages, 24 illustrations. *Harvard studies in comparative literature*, vol. 10, Harvard University Press, Cambridge, 1934. (Five dollars).

Contrary to the opinion of many writers, the works of VIRGIL were popular in the Middle Ages. "His poems were studied in the schools, discussed in the cloisters, quoted by the more enlightened of the Fathers, like AUGUSTINE and JEROME, and in general may be said to have represented

(15) Rythme, 103-4.
(16) Quoted in Études, 168.
(17) Quoted in Études, 186.
(18) Études, 203, 204.

to the cultivated man of the Middle Ages much that SHAKESPEARE represents to the cultivated English-speaking person of today. Dissenters there were about VIRGIL's greatness, just as there had been dissenters during classical times, but his literary reputation survived the vicissitudes of the Middle Ages in undiminished splendor,...".

Not only were the writings of VIRGIL preserved, but many countless stories of his fame and power grew up during these centuries. In this very scholarly and thoroughly delightful work, Prof. SPARGO has traced the origin and development of the medieval and Renaissance conception of VIRGIL as a magician, as represented in the legends beginning with those in the *Policratus* of JOHN OF SALISBURY about 1159 and continuing through the seventeenth century. In the first part of the book are discussed those authors, such as ALEXANDER NECKAM, GERVASIUS OF TILBURY, VINCENT OF BEAUVAIS, JANSEN ENIKEL and others who made the most influential early contributions.

The various stories of VIRGIL's power as a magician are dealt with at some length in the second part. Since every good magician makes talismans, VIRGIL was often represented as the creator of a bronze fly to destroy other flies; a gold leech to destroy a plague of leeches; a meat-market where the food never spoiled; a bronze horse to cure ailing horses; and the very unusual sort of talisman, the *ovum incantatum*, upon which Naples was founded. Of far greater importance than his talismanic art was his ability to create automata, such as the *Salvatio Romae*, the palace, " ...in which stood, with a bell in its hand, a wooden image of each province. Whenever a province plotted against the power of imperial Rome, the image of that province struck its bell. Immediately a brazen soldier astride a brazen horse on the roof of the palace brandished his spear and turned in the direction of the offending province, and troops were dispatched to control the situation... "; and the bronze or copper archers who when struck shot their arrows and extinguished lamps, or everburning fires. Other automata could blow back unfavorable winds or destructive fumes from neighboring mountains, or guard entrances to tombs. Some of these stories are to be found in earlier romances, but not all of them; their common origin is in such treatises as that on pneumatics by HERO of Alexandria (about the first century B.C.), and in many Oriental tales. HERO discussed the science of optics and the uses of mirrors and this is probably the source of the Virgilian legends of the mirror. According to Prof. SPARGO these automata " would seem to owe their existence to the effects upon the non-mechanically-inclined mediaeval mind of scientific and pseudo-scientific experiments of the Greeks as handed down in one way or another. When distance in both time and space had cast a romantic haze over these mechanical toys of

past ages they lost their cogs and pulleys and water-tanks, and became wondrous creations of that incomparable mediaeval Wizard of Oz, VIRGIL the necromancer."

Many of the famous stories in which VIRGIL himself played a leading role are treated in detail; especially that of VIRGIL as a humiliated lover suspended in a basket out of his lady's window, and its companion piece, that of the magician's revenge; his construction of the ***bocca della verità***, the mouth of truth which bit off the fingers of prevaricators; VIRGIL's gift of the ball on the Vatican obelisk which marked JULIUS CAESAR's tomb.

Not only are the principal legends recounted in an interesting manner, but many parallel stories are discussed, and all are traced back through many centuries and many countries. Over a hundred and twenty-five pages of notes and references are included at the end of the book, as well as a transcription of the ***Von Virgilio dem Zauberer***, a fragment of a German chap-book printed about 1520. Thus this study will be invaluable to the special student and more than interesting to the general reader. M. C. W.

Albert Sallet.—*L'officine sino-annamite en Annam.* I. Le médecin annamite et la préparation des remèdes. VII+153 p., 16 pl. (Exposition coloniale internationale, Paris 1931. Indochine française, section des sciences). Paris, G. VAN OEST, 1931 (60 francs).

Nous avons déjà discuté ici assez longuement divers ouvrages consacrés à la médecine chinoise, notamment ceux de FRANZ HÜBOTTER (1929, *Isis*, 14, 255-63), de BERNARD E. READ (1931-2, *Isis*, 20, 584), de K. CHIMIN WONG et WU LIEN-TEH (1932, *Isis*, 20, 480-2) pour ne citer que les plus importants. La présente monographie consacrée à la pharmacopée et aux méthodes officinales sino-annamites est fort intéressante non seulement en elle-même, mais aussi comme élément de comparaison, et nous nous y arrêterons d'autant plus volontiers que nous n'avons pas encore eu l'occasion de parler de la médecine annamite. Ce n'est pas que les ouvrages manquent, mais celui-ci est le premier à paraître depuis la naissance d'*Isis*. On trouvera à la p. 85 une liste de travaux antérieurs qui est déjà assez respectable quoi qu'elle ne contienne que des titres français (voir aussi p. iii).

Les études sur la pharmacopée chinoise ont donné de si bons résultats qu'il vaut la peine d'examiner avec beaucoup de soin toutes les pharmacopées d'Extrême-Orient. Pour ne citer que deux exemples frappants, l'usage de l'huile de chaulmougra et du ***ma huang*** (***ephedra*** sp., d'où est extraite notre éphédrine) est immémorial en Chine (1). Mais peut-on

(1) *Isis*, 10, 240.

vraiment espérer trouver des nouveautés importantes dans des pays qui ont été soumis depuis des siècles à l'influence chinoise? Car il ne faut pas oublier deux choses : D'une part les Chinois, en dépit de l'immensité de leur propre droguier, n'ont cessé d'explorer l'Asie pour y trouver des drogues nouvelles. L'Annam n'a pas échappé à leurs enquêtes et est resté leur source favorite pour quatre produits : cannelle du tronc, cardamome, bois d'aigle, et aloès (p. 50). D'autre part, les docteurs annamites ont toujours considéré la Chine comme leur patrie intellectuelle, et en dehors de leur propre littérature médicale qui, sans être négligeable, est minuscule en comparaison de l'immense littérature chinoise (2), ils n'ont guère étudié que celle-ci.

En fait, pendant longtemps les docteurs annamites durent se contenter des herbiers du Nord (3), et ce n'est que dans la seconde moitié du X[e] siècle que fut publié le premier livre de médecine annamite. L'auteur TUÊ-TINH (4) avait séjourné en Chine, mais il sut appliquer les principes de l'herbier chinois aux plantes de son propre pays, aussi est-il honoré en Annam comme le génie de l'art de guérir et le patron des médecins (p. 7). Depuis, d'autres livres annamites ont été composés (voir p. 8-11)

(2) Parmi les 78,731 volumes cités dans le catalogue impérial de 1818, il n'y a pas moins de 1,915 livres médicaux et 363 livres traitant les sciences naturelles (voir p. 7).

(3) Dans les livres annamites les médecines de Chine sont appelées médecines du Nord; celles d'Annam, médecines du Sud.

(4) J'écris les phonèmes annamites comme l'auteur; on trouvera les caractères chinois correspondants dans son livre aux pages indiquées.

que l'auteur a dûment consultés, mais l'influence chinoise n'en est pas moins restée prédominante. On pourrait dire, je pense, que toute l'armature intellectuelle est chinoise. Je n'ai pas le temps de discuter cette question, mais le dessin et le tableau que j'emprunte au Dr. SALLET sont d'excellents symboles de cette hégémonie séculaire.

Pour en revenir à notre question : Vaut-il la peine d'analyser méticuleusement la pharmacopée annamite ? Sans doute. Tout d'abord nous pouvons espérer trouver en Annam des nouveautés que les Chinois eux-mêmes n'ont pu ni découvrir ni anéantir. Voici

« une méthode qui consiste à faire accepter des médecines en quantités très réduites et absorbées lentement. La prise se fait par la voie inattendue des masticatoires. Un exemple du genre est particulièrement instructif : les ouvriers laqueurs, et ceux qui vont en forêt pour exploiter certains arbres producteurs de la laque, connaissent les éruptions fâcheuses, eczémas et oedèmes, capables d'atteindre certaines susceptibilités organiques. Il existe un moyen de préservation : sur un geste très ancien, on dispose sous la feuille de bétel d'une chique préparée une médiocre quantité de laque vive et l'on use de ce masticatoire avant de se rendre au travail. Nos procédés s'exerçant à propos des anaphylaxies sont mieux présentés sans doute, mais ils sont plus récents. » (p. 54).

D'autre part la question a une portée plus générale : Dans quelle mesure les indigènes d'un pays déterminé parviennent-ils à découvrir les vertus thérapeutiques de leur flore ? Certains peuples y sont-ils plus habiles que d'autres ? A quelles vertus s'intéressent-ils le plus ? Il ne serait pas difficile de multiplier ces questions, mais cela nous amènerait à rédiger tout un programme de recherches sur le folklore médical.

Dans ce domaine comme dans tous les autres il faut savoir être modéré, et éviter à la fois l'écueil du scepticisme et celui de l'enthousiasme irréfléchi. Comme le conseillait il y a un siècle et demi le Père JUAN DE LOUREIRO (1715-96) : " *Virtutes medicas non temere extuli, sed praxi diuturna probatas saepe etiam in libris sinensibus comprobatas. Multae quidem cum medicina europaea conveniunt : aliae quamvis exoticae, non ideo despiciendae, sed amplius probandae.*" (5) Et quarante ans plus tard Mgr. JEAN LOUIS TABERD remarquait à propos du ginseng " *Virtutes hujus panacis a sinensibus exaltantur et ab Europaeis contemnuntur. Medium fortasse amplectandum.*" (6)

Le livre du Dr. SALLET est arrangé comme suit. Il nous décrit ce que fait chez lui dans son officine le médecin préparateur annamite, puis nous parle de la médecine des marchés, des médecins sorciers et des médecins ambulants. Il nous fait entrer dans une boutique de médecin, et en

(5) J. DE LOUREIRO : *Flora cochinchinensis* (Lisbon, 1790, p. xiv).

(6) J. L. TABERD : *Dictionarium annamitico-latinum* (Fredericnagori vulgo Serampore 1838).

Les cinq éléments. 五行 *Ngũ Hành.*	Feu. 火 *Hoả.*	Métal. 金 *Kim.*	Eau. 水 *Thủy.*	Bois. 木 *Mộc.*	Terre. 土 *Thổ.*
Les cinq orientations. 五方 *Ngũ phương.*	Midi. 南 *Nam.*	Ouest. 西 *Tây.*	Nord. 北 *Bắc.*	Est. 東 *Đông.*	Centre. 中 *Trung.*
Les cinq grands viscères. 五臟 *Ngũ tạng.*	Cœur. 心 *Tâm.*	Poumons. 肺 *Phế.*	Reins. 腎 *Thận.*	Foie. 肝 *Can.*	Rate. 脾 *Tì*
Les cinq viscères annexes. 五腑 *Ngũ phủ.*	Petit intestin. 小腸 *Tiểu trường.*	Gros intestin. 大腸 *Đại trường.*	Vessie. 膀胱 *Bàng quang.*	Vésicule biliaire. 膽 *Đởm.*	Estomac. 胃 *Vị*
Les cinq ouvertures extérieures. 五官 *Ngũ quan.*	Langue. 舌 *Thiệt.*	Nez. 鼻 *Tỹ.*	Oreilles. 耳 *Nhị.*	Yeux. 目 *Mục.*	Bouche. 口 *Khẩu.*
Les cinq humeurs. 五氣 *Ngũ khí.*	Sueurs. 汗 *Hãn.*	Crachats. 痰 *Đàm.*	Urine. 小便 *Tiểu tiện.*	Larmes. 淚 *Luỵ.*	Salive. 涎 *Tiên.*
Les cinq saveurs. 五味 *Ngũ vị.*	Amère. 苦 *Khổ.*	Piquante. 辛 *Tân.*	Salée. 鹹 *Hàm.*	Acide. 酸 *Thoan.*	Douce. 甘 *Cam.*
Les cinq planètes. 五星 *Ngũ tinh.*	Mars. 火星 *Hoả tinh.*	Vénus. 金星 *Kim tinh.*	Mercure. 水星 *Thủy tinh.*	Jupiter. 木星 *Mộc tinh.*	Saturne. 土星 *Thổ tinh.*

explique la disposition, le mobilier, la bibliothèque : tout ceci nous est rendu plus familier par d'admirables photographies.

Le chapitre deux est consacré aux médecines elles mêmes: ordonnances (trois exemples analysés et reproduits en facsimile), empaquetage, approvisionnements des médecins. L'auteur a dressé trois listes complètes des drogues tenues en boutique par un médecin de Vinh, et par un autre médecin d'un village du Quang-Nam, et de celles qui sont vendues dans les marchés et aux étalages des rues (p. 17-30) : tous les noms sont donnés en caractères chinois avec transcription des phonèmes annamites et traduction française ou latine.

Chapitre trois : Préparations médicales. Le matériel (chaque instrument si humble soit-il est décrit, et beaucoup sont photographiés). Pesées. Mesures de capacité. Préparation des simples. Distillations. Mesure du temps (division du jour en douze parties égales qui sont désignées par les signes du cycle duodénaire chinois : rat, bœuf, tigre, etc.).

Chapitre quatre : Médicaments et leurs formes. Noms des médecines d'après leurs destinations. Estime comparée des médecines de Chine et d'Annam. Forme des médecines internes et externes. Eaux médicinales. Heures des médecines. Spécialités chinoises et locales (*gia trùyên :* formules de famille).

Chapitre cinq : Actions réciproques des médecines. Diététique médicale. Ce chapitre est peut-être le plus intéressant pour l'étude des traditions chinoises. En effet certaines incompatibilités sont le résultat de l'empirisme, mais la plupart dérivent du rationalisme prématuré et excessif qui caractérise la médecine des Chinois, et de leurs classifications fantastiques (7). L'auteur aurait dû nous indiquer plus clairement ce qui dans tout cela est autochtone, et ce qui ne l'est pas. Il nous parle des « répugnances » de certaines médecines au feu, aux métaux (bronze et fer), des « médecines de crainte », des « médecines hostiles », des « médecines qui troublent », des médecines de renforcement ou de diminution d'action, des médecines dirigeantes. Diététique : prohibitions, surtout *ngu cam* (les cinq interdits) qui sont (p. 80) : « 1. Maladies du sang : interdiction des aliments salés; 2. Maladies des os : interdiction des aliments amers; 3. Maladies de débilitation et amaigrissements : interdiction des aliments à saveur piquante; 4. Maladies des nerfs : interdiction des aliments acides; 5. Maladies des muscles : interdiction des aliments sucrés ». Médecines interdites dans les grossesses. Etc.

Le chapitre six (2 p.) contient la bibliographie européenne, purement française, citée plus haut.

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(7) Voir *Isis*, 14, 257-63.

Le chapitre sept, Notes additionnelles, n'est pas moins intéressant que les autres, mais il suggère que le livre a été composé avec trop de hâte, car l'arrangement en est défectueux. Ce chapitre supplémentaire est presque aussi long que le reste du livre ! Ces notes se rapportent à des sujets tels que ceux ci : Répartitions des qualités des remèdes (résumé d'idées chinoises). Médecine des signatures et magies sympathiques. Coutumes et croyances. Remèdes étranges. Responsabilité médicale en Annam. « Répugnances médicinales ». Proverbes.

J'extrais de cette collection trois proverbes; les deux premiers sont purement annamites, le troisième est d'origine chinoise. Je ne les cite qu'en traduction française, mais j'ajoute des équivalents latins bien connus :

(1) « Médecin, guéris-toi toi-même» *(Medice cura te ipsum)*.

(2) « Malade, on s'inquiète de son corps; guéri, on craint pour son argent ».

Cum locus est morbis, medico promittitur orbis;
Mox fugit a mente medicus, morbo recedente. (8)

(3) « Le remède qui ne fait pas cligner les yeux du malade ne les guérit pas. *(Amaris pharmacis amara bilis proluitur)*. » Enfin un autre proverbe chinois : « Il faut avoir étudié le livre *Dich* avant de pouvoir connaître la médecine » (ce livre est un des classiques confucéens) nous fait penser à l'un des dictons hippocratiques. Il serait vain de vouloir expliquer ces ressemblances par des transmissions; il faut plutôt y voir des preuves nouvelles de l'unité de l'esprit humain.

Il nous manque des index chinois et annamite, mais peut-être ceux ci seront-ils ajoutés quand l'ouvrage sera complet. Espérons que le docteur MENAUT nous donnera bientôt une étude analogue relative au Cambodge, et MM. CREVOST et PÉTELOT, une troisième relative au Tonkin. Il sera fort intéressant de comparer leurs résultats entre eux, aussi bien qu'avec les idées chinoises.

GEORGE SARTON.

Bibhutibhusan Datta.—*The Science of the Sulba. A Study in Early Hindu Geometry*. (Readership Lectures for the year 1931). XVI+ 240 p. Published for the University of Calcutta, 1932.

The " śulbas " or " śulba-sūtras " are manuals for the construction of altars necessary in connection with sacrifices of the vedic Hindus. The number of those manuals may well have run into hundreds but at present we have manuscripts of only seven, namely those of

(8) Voir à ce sujet la pl. 2 dans l'article de C. D. LEAKE (*Isis*, 7, 24).

BAUDHĀYANA (1), ĀPASTAMBA (2), KĀTYĀYĀNA (3), MĀNAVA (4), MAITRĀYAṆĪYA (5), VĀRĀHA (6), and VĀDHULA. Dr. DATTA states that the available śulba-sūtras can be sharply divided into two classes, the class of prime importance including the manuals of BAUDHĀYANA, ĀPASTAMBA, and KĀTYĀYĀNA. "These give us an insight into the early state of Hindu geometry before the rise and advent of the Jaina Sect (500-300 B.C.)." "The four śulbas of the other class add practically very little to our stock of information in this respect."

What sure grounds are there for assigning any such antiquity to the documents as they have now come down to us? (7) None, so far as the reviewer can find out. KAYE gives 200 A.D., rather than 500 B.C.,

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(1) The BAUDHĀYANA śulba was published with an English translation, and critical notes by G. THIBAUT in *Paṇḍit*, a monthly journal of the Sanscrit College, Benares, v. 9-10, 1874-75 and n. s. v. 1, 1877.

(2) The ĀPASTAMBA śulba has been finely edited with German translation, notes, commentary, and introduction by A. BÜRK, *Zeitschrift der deutschen morgenländischen Gesellschaft*, v. 55, 1901, p. 543-591; v. 56, 1902, p. 327-391. He assigns this śulba to the fourth or fifth century B.C. See also G. MILHAUD, "La géométrie d'ĀPASTAMBA," *Revue générale des sciences*, v. 21, 1910, p. 512-520.

(3) The first two chapters of the so-called KĀTYĀYĀNA śulba were published with an English translation and commentary by G. THIBAUT in *Paṇḍit*, n. s., v. 4, 1882, p.

(4) No translation of the MĀNAVA śulba has been published but an account in English with details as to the contents of each of the seven sections has been given by N. K. MAZUMDAR in *University of Calcutta Journal of the Department of Letters*, v. 8, 1922, p. 327-342.

(5) The MAITRĀYAṆĪYA śulba is a different edition of the MĀNAVA. They cover almost the same ground and many passages are identical but the arrangements are different. No translation has been published.

(6) The VĀRĀHA śulbas are very closely related to the MĀNAVA and MAITRĀYAṆĪYA śulbas. No translation has been published.

(7) For further literature see: C. MÜLLER, "Die Mathematik der śulvasūtra. Eine Studie zur Geschichte indischer Mathematik," *Abhandlung aus dem mathem. Seminar der Univ. Hamburg*, v. 7, p. 173-204, 1929; N. K. MAZUMDAR, "On the different śulba sutras," *Proc. and Trans. of the Second Oriental Conference*, Calcutta, 1922, p. 561-564; G. R. KAYE, *Indian Mathematics*, Calcutta, 1915, p. 1-8; M. CANTOR, (*a*) "Über die älteste indische Mathematik," *Archiv d. Mathematik u. Physik*, s. 3, v. 8, 1905, p. 63-72, (*b*) "Gräko-indische Studien," *Zeitschrift f. Mathem. u. Physik*, v. 22, *hist.-lit. Abt.*, p. 1-23 + 1 plate, (*c*) *Vorlesungen über Geschichte der Mathem.*, v. 3, third ed., 1907, p. 635-644; G. THIBAUT, "On the Śulva-sūtras," *Journ. Asiatic Soc. Bengal*, v. 44, 1875, p. 227-275; H. G. ZEUTHEN, "Sur l'arithmétique géométrique des Grecs et des Indiens," *Bibliotheca Mathematica*, s. 3, v. 5, 1904, p. 105-108, (*d*) "Théorème de Pythagore, origine de la géométrie scientifique," *Comptes rendus du II. Congrès internat. de Philosophie à Genève,...* 1904, 1905, p. 833-854; H. VOGT, "Haben die alten Inder den Pythagoreischen Lehrsatz und das Irrationale gekannt?," *Bibliotheca Mathematica*, s. 3, v. 7, p. 6-23, 1906.

as an upper limit. The manuscripts from which recent studies have been made are comparatively modern, and even assuming that some sort of śulba-sūtras did date from before 500 B.C., or 200 A.D., what evidence is there that most of the things of special mathematical interest were not added several centuries later? No such wholesale doubt can be associated with most Babylonian, Egyptian and Greek mathematical documents.

Dr. DATTA explains (quite differently from KAYE) that in the title śulba-sūtra the word sūtra means "an aphorism" or "a short rule," and that the science itself is called the śulba, which was the original title of the manuals. Since the śulba deals with the science of geometry, Dr. DATTA writes "we conclude that the earliest Hindu name for geometry was śulba."

Of all the śulbas, that of BAUDHĀYANA is the longest and possibly the oldest. It contains 525 sūtras; there are 223 sūtras in the śulbas of ĀPASTAMBA and 90 in the śulbas of KĀTYĀYĀNA. The sūtras are often very brief, not more than two lines; but in the printed translation of some, about a score of lines are needed. The śulbas were rules connected with the construction of sacrificial altars which were of different shapes such as a falcon shaped altar built of square bricks, or an altar of the shape of a falcon with curved wings and outspread tail; a heron-shaped altar with two feet; one of the shape of the forepart of the poles of a chariot, an equilateral triangle; another of two such triangles joined at their bases; several wheel-shaped or circular altars, tortoise shaped, etc. The area remained the same when a different shape of altar was required. Thus squares had to be found which would be equal to two or more given squares, or equal to the difference of two given squares; rectangles had to be turned into squares, and squares into rectangles, and the equivalence of area of circles and squares were sought. Such problems inspired the mathematics arising. Some examples of this may be mentioned. As a result of rules for finding the length of the diagonal of a square

$$\sqrt{2} = 1 + \frac{1}{3} + \frac{1}{3\cdot 4} - \frac{1}{3\cdot 4\cdot 34}$$

which is correct to five places of decimals. That the square on the diagonal of a square has twice the area of the square is remarked. Again, a square is *geometrically* enlarged into another square by the addition of a gnomon, two rectangles and a smaller square ($2ax + x^2$) to give another square $(a + x)^2$.

BAUDHĀYANA, ĀPASTAMBA and KĀTYĀYĀNA give the following rule: If you wish to construct a circle equal to a square "draw half its diagonal about the center towards the east-west line; then describe a circle together

with one third that which lies outside the square." This to be interpreted as follows: Let O be the center of a square $ABCD$ with its side AB $(2a)$ oriented east and west. With O as center and OA as radius describe a circle. AB will be a cord of this circle; draw OM perpendicular to this cord meeting the circle in E. Cut off $MP = 1/3\ EM$. Then OP is the radius (r) of the required circle, and $r = \frac{a}{3}(a + \sqrt{2})$. With regard to this discussion involving the cord and height of a segment it is of interest to recall that it was in connection with just such a figure that we have recently learned that the Babylonians of about 2000 B.C. were familiar with the Pythagorean theorem.

To transform a circle into a square BAUDHĀYANA says: "divide its diameter into eight parts; then divide one part into twenty nine parts and leave out twenty eight of these; and also the sixth part of the preceding subdivision less the eighth part of the last." If the diameter of the circle be denoted by d this rule is equivalent to

$$2a = \frac{7d}{8} + \left[\frac{d}{8} - \left\{\frac{28d}{8.29} + \left(\frac{d}{8.29.6} - \frac{d}{8.29.6.8}\right)\right\}\right]$$

or $a = r - \frac{r}{8} + \frac{r}{8.29} - \frac{r}{8.29.6} + \frac{r}{8.29.6.8}$.

Another rule given by BAUDHĀYANA, ĀPASTAMBA and KĀTYĀYĀNA leads to a rule equivalent to the formula

$$a = r - (2/15)\ r.$$

Such problems are not again referred to by any later Indian mathematicians. The corresponding values of π for the three rules would be 3.0883..., 3.0885..., 3.004. A better value of π is given in the MĀNAVA śulba, which states that the square of two by two cubits is equivalent to a circle of radius/cubit and 3 angulis; whence $\pi = 4(8/9)^2 = 3.16...$. the value occurring in the Rhind mathematical papyrus.

The "Pythagorean theorem" is stated quite generally and is illustrated by a number of examples some of which may be summarized as follows:

BAUDHĀYANA: $3^2 + 4^2 = 5^2$, $5^2 + 12^2 = 13^2$, $8^2 + 15^2 = 17^2$, $7^2 + 24^2 = 25^2$, $12^2 + 35^2 = 37^2$, $15^2 + 36^2 = 39^2$.

ĀPASTAMBA: $3^2 + 4^2 = 5^2$, $12^2 + 16^2 = 20^2$, $15^2 + 20^2 = 25^2$, $5^2 + 12^2 = 13^2$, $15^2 + 36^2 = 39^2$, $8^2 + 15^2 = 17^2$, $12^2 + 35^2 = 37^2$.

The Hindus thus formulated their theorem after trial in particular cases. (See T. L. HEATH, *The Thirteen Books of Euclid's Elements*, second ed. Cambridge, v. 1, 1926, p. 360-364; see also the papers of ZEUTHEN, CANTOR and VOGT listed below.) While this discovery may have been independent so far as the Greeks were concerned (HEATH) knowledge of the result may well have come to them from the Babylonians.

Dr. DATTA's work is divided into 16 chapters, the first (p. 1-9) telling

of the different śulbas, the second (p. 10-19) on commentators on the śulbas from the eighth to the seventeenth centuries, the third (p. 20-40) on the " growth and development of the śulba." Dr. DATTA concludes this chapter with the statement that " we have clear proof " of the use of " (1) the theorem of the square of the diagonal, (2) the quadrature of a circle," in the time of the *Satapatha Brāhmana* (c. 2000 B.C.)." The reviewer has not found this " clear proof " convincing. Chapter IV (p. 41-51) is entitled " postulates." This chapter opens as follows : " For the geometrical operations described in the *śulba* the authors, we find, have tacitly assumed the truth of certain other results without any attempt to describe them beforehand or to indicate how they could be effected. These results we have called here postulates of the *śulba*. They might not be postulates in the Euclidean sense of the term; but they can certainly be so called in accordance with the meaning given by ARISTOTLE, namely ' whatever is assumed, though it is a matter for proof and used without being proved '." Among Dr. DATTA's twelve " postulates " the first three are : "(*a*) A given finite line can be divided into any number of equal parts "; " (*b*) A circle can be divided into any number of parts by drawing diameters "; and " (*c*) Each diagonal of a rectangle bisects it." The extent of such a system of " postulates " might be multiplied many times, but discussion of anything of the kind is surely highly misleading. We are dealing with texts containing nothing but rules, and statements concerning altars, and many of these are exceedingly difficult to interpret. There is not a single geometrical figure. There is no mathematical derivation of any rule. The reviewer has strongly felt that, for one entirely ignorant of the contents of the śulbas, it is of fundamental importance that one should have : (1) literal translations of the complete texts, so that one may read and learn exactly what the originals state; (2) interpretations, notes of commentators, conjectures, etc., clearly separated from the texts. In Dr. DATTA's work it is not possible to find to any degree of completeness, just what was in any one of the śulbas. This is partly due to his topical arrangements, " Constructions " (chapter 5, p. 52-71), " Combination of areas " (chap. 6, p. 72-82), " Transformation of areas " (chap. 7, p. 83-94), " Areas, and volumes " (chap. 8, p. 95-103), " The theorem of the square of the diagonal " (chap. 9, p. 104-122), " Rational diagonals " (chap. 10, p. 123-139), " Squaring the circle " (chap. 11, p. 140-151), " Similar figures " (chap. 12, p. 152-164), " Geometrical algebra " (chap. 13, p. 165-177), " Indeterminate problems " (chap. 14, p. 178-186), " Elem. treatment of surds " (chap. 15, p. 187-211), and " Fractions and other minor matters " (chap. 16, p. 212-220). With a fairly complete bibliography, and an index, the volume closes.

Dr. DATTA's volume is one which should be in the hands of every student of the history of mathematics. It is serious in purpose, presents arguments pro and con fairly and fully and contains many original points of view and scores of exact references to authorities and texts. So much information regarding the śulbas has not been earlier available in any readily accessible English source. Coming from a proved scholar long experienced in dealing with historical questions, it will undoubtedly inspire further research leading to more correct views of early Indian geometry and its relation to intellectual achievements of other nations.

R. C. ARCHIBALD.

H. P. J. Renaud et **Georges S. Colin.**—*Tuḥfat al-aḥbāb.* Glossaire de la matière médicale marocaine. Texte publié pour la première fois avec traduction, notes critiques et index. XXXIV+218+75 (Arabe) p. (Publications de l'Institut des hautes études marocaines, 24). Paris, GEUTHNER, 1934.

Le *Tuḥfat al-aḥbāb fī māhīyat an-nabāt wal-a'shāb* (Don précieux aux amis traitant des qualités des plantes et des simples) — traité marocain anonyme de matière médicale — n'est pas une nouveauté, mais il faut savoir gré aux auteurs de nous en avoir préparé de longue main une édition critique aussi soignée, et pourvue de notes abondantes. Une traduction française en fut publiée pour la première fois par ALPHONSE MEYER dans le *Journal de médecine et de pharmacie de l'Algérie* en 1881, et une deuxième traduction (incomplète) fut publiée vingt cinq ans plus tard dans l'ignorance certaine de la précédente par G. SALMON : Sur quelques noms de plantes en arabe et en berbère (*Archives marocaines*, vol. 8, 1906). Dans son *Dictionnaire des noms des plantes* (Le Caire, 1930; *Isis*, 20, 586), AHMED ISSA bey nous signale que ce texte fut imprimé à Alger en 1881. Comme cette indication est donnée dans le texte arabe (p. xiii) j'avais pensé d'abord qu'elle se rapportait à une édition arabe, mais sans doute s'agit-il de la traduction française portant la même date? Je note qu'AHMED ISSA bey connaît cette traduction et en a fait usage tandis que les savants éditeurs de Rabat ne mentionnent ni son ouvrage, ni celui plus ancien de GEORG SCHWEINFURTH (1836-1925) : *Arabische Pflanzennamen aus Aegypten, Algerien und Jemen* (Berlin, 1912; *Isis*, 1, 268-71).

Les deux traductions antérieures dérivaient chacune d'un seul manuscrit; leur collationnement mit en lumière des dissemblances inquiétantes. Le nouveau texte est établi sur trois manuscrits, plus la traduction de celui d'Alger.

L'auteur en est inconnu mais il était certainement un Marocain du Sud, car il dit '*indanā* (chez nous) en parlant de Marrakech, et appelle

les Fezzans, *ahl Fās* (les gens de Fez); son vocabulaire berbère appartient surtout à la *tashelḥīt*. « Enfin, à diverses reprises, il cite des plantes qui poussent au Dar'a et des produits importés du Soudan, avec lequel Marrakech est en relations plus suivie que toute autre ville du Maroc. » (p. iii). L'époque est également inconnue, mais elle est sûrement tardive, et ce traité n'intéresserait guère les mediévistes si ceux-ci ne devaient tenir compte du conservatisme maghrébin qui a continué le moyen âge jusqu'à nos jours.

« La *Tuḥfa* apparaît, en somme, comme l'équivalent de ces appendices que beaucoup d'auteurs ont placés à la fin de leurs traités de médecine, sous des titres tels que celui de *Tafsīr al-asmā'* « explication des noms », et qui dans les cas où il n'est pas possible de condenser en quelques lignes les renseignements nécessaires, renvoient, purement et simplement, à l'article détaillé de l'ouvrage proprement dit. On ne saurait comprendre autrement l'expression *'alā bābihi* « (voir) à son chapitre », qu'on rencontre ça et là dans la *Tuḥfa*. Mais quel est le traité auquel ces citations renvoient? Nous ne sommes pas encore en mesure de le préciser... » (p. v). « Nous voyons donc, en résumé, dans la *Tuḥfa*, un *Kashf ar-rumūz*, vocabulaire synonymique, extrait probablement d'un traité général de médecine qui ne nous est pas encore parvenu, un guide à l'usage non seulement, comme le pensait SALMON, des *ṭolbā* guérisseurs et des *'ashshābin* « herboristes » ou *'aṭṭārīn* « marchands d'épices et droguistes », mais encore des simples lettrés marocains ». (p. vi).

Le texte contient 462 articles rangés dans l'ordre alphabétique (*abajad* maghrébin). Il s'y trouve beaucoup de synonymes berbères et quelques synonymes romans (*'ajamiyya*). Les notes philologiques, historiques, médicales et botaniques des auteurs sont beaucoup plus étendues que le texte arabe, et seront fort précieuses. Ces notes sont naturellement basées sur DIOSCORIDE, IBN BIKLĀRISH (*Introduction*, 2, 235) and IBN AL-BAIṬĀR, mais aussi sur trois ouvrages postérieurs fort importants :

« Pour l'époque qui succède au Moyen Age, et au cours de laquelle la science arabe suit les émigrés d'Espagne pour se réfugier au Maghrib, nous avons disposé, comme sources occidentales : 1) de trois manuscrits d'un ouvrage encore inédit, la *Ḥadīqat al-azhār* du Wazīr AL-GHASSĀNĪ (XVI^e^ s.), œuvre purement marocaine, qui fournit de bonnes descriptions botaniques et des synonymies précieuses dans le parler de Fès. 2) Du *Kashf ar-rumūz* de 'ABD AR-RAZZĀQ al-Jazā'irī (XVIII^e^ s.), ouvrage algérien, d'inspiration orientale, mais qui nous semble avoir souvent puisé, pour ses synonymies vulgaires, à des sources marocaines. Des vérifications ont été apportées à la traduction déjà ancienne qu'en avait donné LECLERC, par le Dr. GABRIEL COLIN, professeur à la Faculté des Lettres d'Alger, mort récemment, au moyen de l'édition arabe imprimée dans cette ville en 1903-04, ouvrage que nous avons également utilisé. 3) Du *Ḍiyā an-nibrās* de 'ABD AS-SALĀM AL-'ALĀMĪ (XIX^e^ s.), sorte de glossaire, où ce marocain, instruit en Égypte auprès de maîtres français, a tenté de donner à ses compatriotes la correspondance dans le parler de Fès, des termes techniques contenus dans la *Tadhkira* de DĀWŪD AL-ANṬĀKĪ, compendium de la pharmacopée orientale. 'ALAMĪ reprend aussi la tradition

ancienne, en citant de nombreux auteurs maghribins dont les œuvres ne nous sont pas encore connues; aussi, malgré ses imperfections, son livre s'est révélé à l'usage comme une source de renseignements inédits ». (p. xiii).

(AHMED ISSA bey n'a fait usage que de la deuxième de ces trois sources maghrébines). Le *Diyā an-nibrās* a été lithographié à Fez en 1900. Pour ce qui concerne IBN AL-BAIṬĀR, les auteurs se sont servis non seulement de DOZY et de LUCIEN LECLERC mais aussi d'un assez bon manuscrit du *Jāmiʿ al-mufradāt* (Rabat) qui contient dans ses marges certains synonymes en arabe marocain et en berbère (1).

L'ouvrage comporte des index français, latin et arabe, assez étendus. Sa publication nous a fait le plus grand plaisir. GEORGE SARTON.

George Sarton.—*Introduction to the history of science*, vol. I : From HOMER to OMAR KHAYYAM. XII+840 p. Vol. II : From RABBI BEN EZRA to ROGER BACON. In 2 parts. XXXV+1251 p. Baltimore, WILLIAMS & WILKINS, 1927-31 ($22).

Dr. ERNST ZINNER, Director of the Remeis Observatory in Bamberg, well known to our readers through his history of astronomy (Berlin 1931, *Isis* 16, 161-7) and more favorably by his very precious catalogue of astronomical Mss. (Munich 1925 ; *Isis* 15, 193-5) has done me the honor to discuss my *Introduction* in *DLZ* (1933, 1287-92). Furthermore, he has kindly sent me a series of errata and addenda some of which are published as usual in our Critical Bibliography (no. 39) ; others which could not be published in that way follow. G. S.

1. PACIFICUS Archidiaconus Veronensis, der zur Zeit des LOTHAR, des Sohnes von LUDWIG D. FROMMEN, lebte, erfand eine Nachtuhr (UGBELLUS, *Italia sacra*, t. 5, 609).

Von folgenden Personen, die vor 1300 n. Chr. arbeiteten, lassen sich Handschriften gemäss meinem Handschriftenverzeichnis (Munich 1925) nachweisen :

2. ASCELINUS TEUTONICUS
3. AETHELHARD
4. AFINDUS
5. AGIUS
6. BERENGAR
7. JOH. V. BRAUNSCHWEIG
8. COLUMBANUS
9. DUNGALUS
10. ECKEHART IV v. ST. GALLEN
11. FORMETUS
12. GODWINUS
13. HARTMANN D. III v. ST. GALLEN
14. HEINRICH

(1) MAX MEYERHOF a démontré qu'IBN AL-BAIṬĀR fut surtout un grand plagiaire (Le Caire, 1932, *Isis*, 20, 454-7), mais si cela diminue notre admiration pour lui, l'œuvre même reste une source de tout premier ordre quelle que soit sa genèse.

15. JOH. V. PAVIA
16. HILARIUS
17. HIERONYMUS
18. JERGIS
19. KONRAD (s. auch Kaltenbrunner)
20. OTTO V. KAPPENBERG
21. REINHER V. PADERBORN
22. PASCHASINUS (PASCASSINI)
23. JOH. V. PULCHRORIVO
24. JOH. V. SACHSEN
25. POLTMEUS SILVIUS
26. SISEBUTUS
27. WICHRAM.

Ferner nennt HOUZEAU astron. Handschriften im Vatikan zu Rom von:

28. VOLCOMANNUS Monachus Augiensis
29. TEUTCARIUS Mon. St. Galli (computus).

Es fehlen die Babylonier:

30. BETHEM (ZINNER Verzeichnis)
31. NABURI'ANNU und KIDINNU s. Fr. K. KUGLER, *Sternkunde und Sterndienst in Babel*, II. Buch, Münster 1909-32, an verschiedenen Stellen, besonders auf S. 582-621; ferner in P. SCHNABEL, BEROSSOS, Leipzig, 1923.

Zu erwähnen wären auch:

32. NECHEPSO und PETOSIRIS (Fr. BOLL, *Sphaera*, Leipzig 1903; ZINNER, *Verzeichnis*, 7682/3.

(*Bamberg*) ERNST ZINNER.

Benjamin P. Kurtz.—*The pursuit of death*. A study of SHELLEY's poetry. XXII+339 pp. Oxford University Press, New York, 1933. ($3.50).

Recognizing that SHELLEY the lyric poet was also a keen speculative mind, Professor KURTZ analyses his thought upon the subject which engaged him most constantly: how a man may cope with death. From the lugubrious death which decorated the gothic romances of SHELLEY's boyhood, through the experience of HARRIET SHELLEY's horrible death, to his own desire for death in the weeks just before he was overtaken by a storm while sailing in the Bay of Spezzia and drowned, SHELLEY attempted to overcome death in his own mind. Early in his career as a poet he decided that death and dejection are to be met by building Utopias and by summoning oneself to high ethical adventure (*Prometheus Unbound* and *Ode to the West Wind*). This discovery Mr. KURTZ calls the Moral Victory over death. Then SHELLEY perceived that by a fusion of physical and ideal love (*Epipsychidion*) one may overcome his revulsion at the ugliness of death; this was the Aesthetic Victory. Finally the poet decided that death offers the human spirit a chance to return to the great *anima mundi*, losing its little identity in the mighty life force:

> From the world's bitter wind
> Seek shelter in the shadow of the tomb.
> What Adonais is, why fear we to become?

Such a death as that of JOHN KEATS, said the poet, is desirable because it brings liberation from particular self. This in Professor KURTZ's opinion is the Mystical Victory.

His analysis of these opinions of SHELLEY's is so sympathetic, attends so carefully to the lyrical (that is, unsystematic and occasional) discovery of them and to their metaphorical expression, and yet on the other hand observes so accurately the recurring metaphysical intent of SHELLEY's rational mind that few can quarrel with Professor KURTZ's exposition of what, in philosophical terms, SHELLEY said. A romantic naturalist, a rational meliorist, and frequently a believer in the platonic ideas, SHELLEY nevertheless showed himself at heart a Galenist. The metaphysics of his great poem, *Adonais*, is the metaphysics of the φύσις :

> ... the one Spirit's plastic stress
> Sweeps through the dull dense world, compelling there
> All new successions to the forms they wear.

Ultimately, SHELLEY sought a higher synthesis of opposites similar to that which during his lifetime GEORG WILHELM FRIEDRICH HEGEL propounded in Germany.

Professor KURTZ, himself an Hegelian or near-Hegelian, is admirably equipped to analyse the progress of SHELLEY's thought. For example, he notices SHELLEY's love for the platonic idea in the first four stanzas of the *Hymn to Intellectual Beauty* and his distress in the face of the irreconcilable enmity of all earthly, imperfect things : the Spirit of Beauty opposes Chance and Mutability. To resolve this dual reality in SHELLEY's mind, says Mr. KURTZ, it was necessary for the poet to discover " some archaestheticism, which recognizes consciousness as a primitive attribute of ' matter.' " Ultimately Mr. KURTZ observes the accomplishment of this resolution by means of what he calls SHELLEY's " poetic, animistic imagination," which brings about a " mystical fusion of mind and matter." In *Adonais*, says Professor KURTZ, is to be found " a monism that discovers reasonably a higher synthesis in a substantial ground of mind and matter ; an objective idealism that resolves mind and matter, or the Many, into an indescribable reality, or the One." As one reads Mr. KURTZ's analysis he has little doubt that if SHELLEY had heard the Hegelian jargon and could have endured its cacophonies he would have assented to its metaphysical import.

But though intent upon analysis, Mr. KURTZ cannot avoid making general judgments, and to these the reader who is not an Hegelian must object. For example, FRANCIS THOMPSON, in spite of the fact that he was a lover and admirer of SHELLEY, could discover in *Adonais* no real victory over death ; for the conception of immortality set forth

in the poem, said THOMPSON, " thrusts you into death, the maw of Nature, that your dissolved elements may circulate through her veins ". To this Mr. KURTZ replies :

" To SPINOZA and, I believe, to SHELLEY, this indignation would appear the result of an eloquent confusion of personality with individual mind. It is a confusion, perhaps, of personality in its bondage to wordly desires, with deepest thought's approximate freedom from those desires, from the hopes and fears that are the slavish attendants of possessions."

To be free from the desires attendant upon possessions, Mr. KURTZ says, one must think of personality as persisting only in " the one Spirit's plastic stress " that " Sweeps through the dull dense world " : that is, the *anima mundi*. By implication, I suppose, we must infer that such a thinker as SOCRATES, who did not hope for immortality by merging his personality with the Soul of the natural world, was confused in his idea of the self by the desires, hopes, and fears that are the slavish attendants of possessions ! Mr. KURTZ's reasoning reveals the shabbiness of HEGEL's account of man. The hopes and fears attendant upon the failures of man's Will and our knowledge of human destiny are what show to the Socratic thinker the nature of personality. HEGEL, by contrast, has recourse to Reason, discovering in the rational resolution of antitheses a singleness of which Will forms no part. Mr. KURTZ boasts of SHELLEY's similar synthesis of beauty and ugliness by means of the Senses and Reason, but this rationalistic view of experience in fact distracts SHELLEY from the lot of man and leads him into a mystical assertion of the superior " somehow oneness " little related to human fate. When the Hegelian mist has cleared away, the Socratic thinker will return to FRANCIS THOMPSON's comment on *Adonais :*

" Why, through the thin partition of this consolation Pantheism can hear the groans of its neighbour, Pessimism."

In this part of Mr. KURTZ's criticism, the human and the natural are confused. He calls *Adonais* a " mystical victory " over death in which is to be found " a synthesis of life and death in an indescribable end or ' substance.' " Mystical passages of poetry, he says, " by their imaginative animation of natural phenomena with intelligent intention, suggest a ' somehow ' identity of mind and matter, or an *anima mundi* " ; " mysticism is of the essence of all deep aesthetic experience." In support of this romantic view he hails in ARISTOTLE :

" For, as ARISTOTLE said, poetic truth is a representation of things not as they are, but as they might or should be; and this mystical guess, or vision, is of how *all* things *might be* in reality. "

But when ARISTOTLE said this in the Poetics, a " quick,... evanescent impression of a ' somehow ' oneness of all things," to quote Mr. KURTZ, " a sense of something religious and sublime " was farthest from his thought. ARISTOTLE was saying that poetry tells the probable, which is discovered by understanding what is universal in human life. No talk of synthesizing nature and men's minds in ARISTOTLE's Poetics. On the contrary, ARISTOTLE separated nature and man by what, without properly describing it, Mr. KURTZ calls PLATO's " sulky dualism."

In his intense affection for SHELLEY's thought as well as his poetry Mr. KURTZ follows the poet into a fundamental misunderstanding of that dualism. Dualism is represented to Mr. KURTZ in the possibility that " all ugliness may some day yield to the ideal loveliness." " Dualism," he comments, " must always sacrifice the present to the future." But a moment's reflection upon SOCRATES's temperate, un-hasty interest in the present reminds us that in the thought of that great dualist there was no nostalgia for the future, at least none to match the intense longing of the romantic monists. At ground Mr. KURTZ implies that the dualism which SHELLEY avoided was that between gloomy human life and elusive ideal perfection, an antithesis to be resolved by some sort of evolution, as though the question were wholly rational. But in PLATO the dualism derived from the opposition of man's higher and his lower nature and consequently involved his desires and choices as well as his thoughts.

One could continue picking quarrels of this sort with Professor KURTZ, but accumulated they would become a general contest over Hegelianism and extend beyond the limits of a review. That contest is critical; for Mr. KURTZ's analysis, on the other hand, I have more words of praise to add to those already given. Unlike many writers on the ideas of the romantic poets he attempts to distinguish between the teachings of PLATO and the platonic tradition, and his attempt suggests how the old confusion of the two in modern criticism may be avoided. Furthermore, his demonstration that " if SHELLEY ever really thought he was a disciple of BERKELEY, he was a confused disciple " helps to untangle much in the reader's mind.

Still another remark should be made about the relation of the foregoing discussion to our understanding of SHELLEY. Followers of HEGEL who read Mr. KURTZ's book will discover in SHELLEY a very great poet in the fullest sense of the term and will be inclined to agree with him that some of SHELLEY's longer poems are to be compared with the best of EURIPIDES, DANTE, SHAKESPEARE, and MILTON. Non-Hegelians like myself should think no less of SHELLEY the lyric poet after reading Mr. KURTZ's lively book; the virtue of SHELLEY's rich romantic poetry abides. SHELLEY's ideas are clarified for any reader of *The Pursuit*

of Death, and he will set the book down better able to perceive in the bright intellectual frenzies which illuminate *Prometheus Unbound*, *The Triumph of Life*, and *Adonais* itself a philosophy which in pedestrian fashion entered before and during SHELLEY's lifetime into many minds on the continent of Europe. GORDON KEITH CHALMERS.

Hugo Dingler.—*Geschichte der Naturphilosophie*. 174 pp. JUNKER und DÜNNHAUPT Verlag, Berlin, 1932.

This book gives a compact, systematic survey of the history of the principles of the natural sciences, together with a correlated history of philosophy in so far as the latter relates to nature. The book is no mere recording of facts, but a unique and illuminating criticism of the methods which have been employed in the development of the philosophy and science of nature. In the opinion of the reviewer the sort of methodological analysis presented in this book is the most interesting phase of the history of science.

It would be difficult to name any one better prepared for his task than Professor DINGLER. During the past twenty-five years he has been a very active worker in the methodology of the exact sciences. Among his works have been, *Grundlagen der angewandten Geometrie* (1911), *Grundlagen der Naturphilosophie* (1913), *Grundlagen der Physik* (2nd ed. 1923), *Physik und Hypothese* (1921), *Der Zusammenbruch der Wissenschaft* (1926), *Das Experiment* (1928), *Philosophie der Logik und Arithmetik* (1931). But he has also studied the broader philosophical problems. Thus in recent years have appeared *Metaphysik als Wissenschaft vom Letzten* (1929), *Das System* (1930). With such works behind an author one would expect that an account of the history of the philosophy of nature would reveal his scholarship and critical insight at its best.

For the reviewer these high expectations were realized. Professor DINGLER begins with the animistic natural philosophy of primitive people. But the real beginning of science and philosophy is with the Greeks, who created the idea of a rational system which is founded upon principles. In crisp, precise phrases Professor DINGLER characterizes the natural philosophy of the classical Greeks and describes its decline under sceptical criticism through failure to solve the problem of the ground of validity of rational systems. He gives relatively more than the usual amount of space to the Alexandrian period, the early development of Christian doctrine, Arabic philosophy and scholasticism. The scholastics made an heroic attempt to solve the problem of validity by recourse to religious faith. But they found it impossible to reconcile this irrational element, which had been contributed principally by the Neo-platonists and

St. AUGUSTINE, with the exact methods of Greek thought. The dawn of a modern era was heralded by the discovery of the methods of describing change and of experiment. After a transition period during which individual sciences such as mechanics and biology were developed the ground was prepared for the great systems of the seventeenth century. There followed the empiricistic criticism of the eighteenth century, which stimulated the creation of a new philosophical method by KANT. The extravagance of KANT's successors, however, cast doubt upon his achievements. During the nineteenth century there was developed an empiricism, and a mathematical interpretation of nature which overlooked the fundamental philosophical problem of validity.

The basis of scientific method is experiment and calculation. Flushed with the success of science the modern mind has been inclined to take the significance and validity of these methods for granted. But in the past few decades an appreciation of this problem has grown. None has contributed more than Professor DINGLER. The essence of his view is that the apparatus which is employed in performing an experiment is constructed so as to embody the principles of classical physics. Thus our fundamental principles are a priori definitions, they are principles of interpretation of phenomena and not abstractions from phenomena. In his history of the natural sciences Professor DINGLER finds ample opportunity to exemplify his views. Thus LAVOISIER based quantitative chemistry upon the principle of the conservation of matter. But this was an a priori definition in terms of which he interpreted his experiments with the beam balance. The principle of the conservation of energy likewise is an instrument for the interpretation of phenomena. Professor DINGLER's admirable little book teaches the failure of empiricism in philosophy of science. In order to describe nature we must approach the problem with a priori regulative principles which are embodied in our apparatus. In particular, Euclidean geometry and Newtonian mechanics are embodied in all our measuring instruments. The reviewer wholly agrees with this, but thinks that the classical theories should be viewed as first approximations to a more general geometry and mechanics. The particular measurements are indeed interpreted in terms of the classical concepts, but in order to describe physical phenomena ranging through the vast extent of nature it appears that simplicity demands the acceptance of the conceptual system of relativity as a higher approximation.

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Collected Papers of Charles Sanders Peirce.— Volume III: *Exact Logic.* Edited by CHARLES HARTSHORNE and PAUL WEISS.

Harvard University Press, Cambridge, Mass., 1933 ($ 5.00.) (1).

This volume, third in the projected set of ten, contains the more mathematical of PEIRCE's previously published writings in logic. The papers are arranged in chronological order, spanning most of the period from BOOLE's *Laws of Thought* to *Principia Mathematica*.

BOOLE restricted logical addition to the case of mutually exclusive classes, so as to preserve equality between the cardinal number of the logical sum and the arithmetical sum of the cardinal numbers of the addends. JEVONS, then, took a step toward the emancipation of logic from such enslavement to arithmetical analogy by introducing the modern unrestricted logical addition. PEIRCE, as yet unaware of JEVONS' work, repeats this step in the opening paper (1867). He shows how the innovation facilitates the exercises of the day, namely the treatment of probability through logical algebra and the solution of logical equations through development and elimination. A further departure from BOOLE appears in PEIRCE's discussion of probability; he recognizes the need, namely, of a special primitive idea "a_b", "the frequency of b's among the a's."

In another paper of the same year PEIRCE advances the thesis that all principles presupposed by mathematics may be construed not as assumptions but as clauses definitive of the mathematical subject matter. In this way all assumptions become relegated to the extra-mathematica. sphere in which the notions thus defined receive application. The paper is part I of a series which was never continued. Within the limits of the one installment PEIRCE only begins substantiation of his thesis by defining the notions of a modified Boolean algebra and deriving a few theorems from the definitions. The development is lacking in rigor, but the thesis itself is a significant foreshadowing both of *Principia Mathematica* and of the logical positivism in current epistemology.

In point of the Procrustean fulfillment of mathematical analogy, this second paper is a step backward. PEIRCE not only retains BOOLE's restricted logical addition, or "arithmetical addition," along with his own general logical addition, but also introduces an invertible (2) "arithmetical multiplication," somewhat parallel to the arithmetical addition, to accompany the general logical multiplication inherited from BOOLE. PEIRCE uses this arithmetical multiplication only where the Boolean algebra is applied to events (*e.g.* for probability theory) rather than to classes; he defines "ab" namely as the events a and b taken conjointly, and restricts the operation to the case where a and b are

(1) The first two volumes were reviewed in *Isis*, vol 19, pp. 217-29.

(2) *I.e.*, such that "$ab = c$" determines a uniquely in terms of b and c.

" independent " in an obscurely defined sense. Another case of strained arithmetical analogy appears in PEIRCE's confinement of his theorem of the invertibility of " arithmetical " (*i.e.* BOOLE's logical) addition,

$$\text{If } a + b = c \text{ and } a' + b = c, \text{ then } a = a',$$

to the case where b is not all-inclusive. The theorem is true also if b is all-inclusive, for then, since " arithmetical " addition is restricted to exclusive addends, a and a' are both determined as the empty class. PEIRCE's exception of this case was an attempt to maintain analogy with the fact that the corresponding theorem of the invertibility of addition in arithmetic does not hold when b is an infinite cardinal. His motive for thus frantically seeking to maintain the analogies seems to have been that he planned to construe genuine arithmetical operations as in a manner special cases of the operations of Boolean algebra, arrived at through abstraction from certain aspects of the terms involved. Thus, in the fragment at hand he defines equality between natural numbers as identity between classes considered in abstraction from all properties save their respective multiplicities.

Next comes PEIRCE's earliest published paper on the logic of relatives (1870), in which he replaces DEMORGAN's haphazard notation by a more efficient one. By a relative he does not mean what is termed a relation in present usage; rather, where R is a dyadic relation the corresponding dyadic relative in PEIRCE's sense might be phrased " an R of", or " a term standing in the relation R to," and is therefore to be regarded approximately as that which is represented by the fragment of symbols " $\breve{R}$ " in *Principia Mathematica*, as in the context " $\breve{R}`x$". PEIRCE was too close to traditional logic, however, to distinguish between classes and individuals in this connection. He would have regarded $\breve{R}`x$, " the R's of x," and $\breve{R}``\alpha$, " the $R$'s of members of $\alpha$", and even, in the case of a one-many relation, $R`x$, " the $R$ of $x$," as essentially alike. His relative corresponding to a relation $R$ may therefore be regarded indifferently as expressed by the incomplete symbols " $\breve{R}$", " $\breve{R}$`` " or " $\breve{R}$` " of *Principia*; the first is the most generally applicable in practice.

PEIRCE formulates the neat terminological doctrine that the name of any operation, when applied by analogy to a similar operation in another field, should be so applied that the two mutually analogous operations of the respective fields can thereupon be construed as cases of a more general unified operation which bears the name in question and whose field embraces both original fields. The adoption of an established operation name for use in another field must thus consist in finding a single conception adequate to both special operations. As such a

general conception for ***multiplication*** PEIRCE adopts the notion of the application of a relative in such a way that, where L and B are the relatives "lover of" and "benefactor of" and γ is the class "woman," $L\gamma$ is "lover of a woman" and LB is "lover of a benefactor of." Thus, where Q and R are the relations respectively of loving and of benefitting, PEIRCE's relative product $L\gamma$ is the $Q`\gamma$ of *Principia Mathematica*, while his relative product LB is the relative corresponding to the relation $Q \mid R$, *Principia*'s "relative product."

PEIRCE points out that this concept of multiplication satisfies his terminological canons by squaring with numerical multiplication since for example "2×3" may be read "pairs *of* triples." Multiplication as thus conceived covers also the application of relatives to arguments in mathematics, *e.g.* in such expressions as "sin x," "log x," "dx" etc. By an elegant device PEIRCE contrives furthermore to construe the ordinary logical product of classes α and γ, written "α,γ" in his notation, as a case of the general multiplication described. He regards the comma as expressing a unary operation upon the term to which it is suffixed, of such kind that "$\alpha,$" denotes the relative "α which is." Thus, just as "$L\gamma$" means "L of a γ," so "$(\alpha,)\gamma$" or "α,γ" means "α which is γ," *i.e.* the common part or logical product of α and γ. The comma is applied similarly to relatives; the result is in each case a relative of next higher degree. (3) Thence comes the logical or ***absolute*** (as against relative) multiplication of relatives: thus "L,B", for the given values of L and B, means "lover and benefactor of."

In the introduction of addition and involution PEIRCE observes no such neatly unified principle as in multiplication; his sole guide here is the satisfaction of certain general formulae, *e.g.* the laws of exponents. In this paper he confines addition to the ordinary logical or absolute addition of classes and relations, introducing no relative addition, parallel to relative multiplication, until a much later writing. Involution on the other hand is relative only, being given no analogue in the absolute sphere. There are two relative involutions, ***progressive*** and ***regressive***. The former is so construed that "L^{γ}" and "L^{B}," for the given L, B and γ, mean "lover of all women" and "lover of all benefactors of." Regressive involution, written with initial exponent, is such that "${}^{L}\gamma$" and "${}^{L}B$" mean "lover only of women" and "lover only of benefactors of."

In the remaining developments PEIRCE's emulation of arithmetic is unrestrained. Despite the necessity *e.g.* of distinguishing (log x)y from

(3) I appropriate here the word applied by Professor H. M. SHEFFER to relations. The degree of a relation is the number of correlated terms: n in the case of an n-adic relation.

log *(xy)*, he insists upon preserving the appearance of associativity for his general multiplication, even to the extent of introducing an elaborate system of subscripts to supplant parentheses in such contexts. On the basis of the subscript scheme he goes on to define the number 1 in various senses: as the relative of identity, as the all-inclusive class and as the cardinal number 1. 2 is then treated similarly. The development is valueless in view of modern methods, since it depends upon the confused notion of propositional quantity as inhering in a name (*e.g.* " something ") in its own right rather than as applying to an entire propositional function with respect to a given variable. From these ideas PEIRCE constructs a far-fetched and fantastic calculus along mathematical analogies, establishing logical correspondents to logarithms, infinitesimals, differentials, quaternions, $\sqrt{-1}$, π, e, the binomial theorem, and TAYLOR's and MACLAURIN's theorems.

PEIRCE's non-symmetrical copula " $-<$ " is best read as inclusion, although, not yet having access to PEANO's notion of the unit class as distinct from its member, PEIRCE would construe the copula also as membership when the left copuland is singular and the right general, and as identity when the right is singular. When both copulands are propositions, furthermore, PEIRCE treats his copula as material implication. This may be grasped by construing a proposition as the class of cases in which it is true, and hence as all-inclusive if true and empty if false. In a paper of 1880 PEIRCE argues the logical priority of his inclusion or implication over identity, on the grounds (1) that implication comes of weakening the psychologically basic connective " *ergo* " by ceasing to assert the copulands, and (2) that inclusion is a genus of and therefore logically simpler than identity, which latter is that special case of inclusion in which the converse inclusion also obtains.

In the same paper PEIRCE develops the moods of the syllogism by means of his copula together with negation, and then proceeds to sketch his Boolean algebra, this time with especial reference to an effective technique for eliminating terms from sets of premisses. Next he sets forth his algebra of relatives, in which he has now dispensed with the fetish of mathematical analogy and retained only the valuable notions: the absolute operations of negation, addition and multiplication, the unary relative operation of voice change or extraction of the converse, and the binary relative operations of multiplication and progressive and regressive involution. Adjunctively to his treatment of the one transpositional operation upon dyadic relatives, voice change, PEIRCE discusses the five possible transpositional operations upon triadic relatives and lists all identities between compounds of pairs of such operations. He rounds out the symmetry of the three binary relative operations by

adding a fourth, *transaddition*, written " $x \circ y$ " and defined as $\bar{x}\bar{y}$, the relative product of non-x and non-y.

By 1883 PEIRCE has abandoned transaddition and the two involutions. In a paper of that year he introduces in their stead the operation of relative addition, $x \dagger y$, which is the negative of transaddition. Relative multiplication and addition are the only binary relative operations mentioned in his subsequent work.

In the last mentioned paper and in a note of the preceding year PEIRCE so construes the relative as to make it indistinguishable from *relation* in the current sense. He supposes all ordered couples arrayed in an indefinitely large square so that couples within a rank agree as to first member and couples within a file agree as to second, while second members of couples follow the same sequence S along the ranks as do first members along the files. Similarly PEIRCE supposes all triples disposed in a cube. Dyadic or triadic relatives are regarded as sums of all the units of the square or cube, with a numerical coëfficient, vanishing or otherwise, attached to each. For a relative x the coëfficient of the ith-by-jth unit of the square is symbolized " x_{ij} ". The propositions " *aRb* " and " $\backsim$ *aRb* " of *Principia Mathematica* notation are thus expressed by the respective formulae " $R_{ij} > 0$ " and " $R_{ij} = 0$," where a and b are respectively the ith and jth individuals according to the arbitrary world-ordination S. Constant relatives and operations upon relatives are defined by giving the form of the coëfficients in terms of variable coördinates on the square or cube; thus identity, I, is defined by the numeral equations " $I_{ii} = 1$ " and " $I_{ij} = 0$," the converse of a relative is defined by the equation " $\breve{x}_{ij} = x_{ji}$ ", and the relative product and sum by the equations

$$(1) \qquad (xy)_{ij} = \Sigma_n x_{in} y_{nj}$$

$$(2) \qquad (x \dagger y)_{ij} = \Pi_n (x_{in} + y_{nj})$$

where " Σ_n " and " Π_n " denote the usual numerical summation and production of all values of the appended function of n. (3)

In numerical summation and production PEIRCE has a device for expressing particular and universal propositions, since " $\Sigma_{ij} x_{ij} > 0$ " and " $\Pi_{ij} x_{ij} > 0$ " imply respectively that at least one and that all of the coëfficients in the relation x are non-vanishing, or in other words that x obtains, respectively, between one couple and between all couples. Similarly *e.g.* " $\Sigma_i x_{ij} > 0$ " and " $\Pi_i \Sigma_j x_{ij} > 0$ " express respectively that the element correlated with the number j is in the converse domain of x, and that the domain of x is all-inclusive.

(3) Since the summation would in general yield a number exceeding 1, the stipulation is required that for present purposes numbers exceeding 0 know no distinction.

Through a convention which PEIRCE introduces to the effect that in all propositions of the form "$k > 0$" the last two signs shall hereafter be left tacit, a convenient and modern notation for quantification is achieved; the suffix "> 0" becomes deleted from the above quantitative propositions. We can think of "i" and "j" as denoting individuals; it is immaterial that the denotation has been conceived as indirect *viâ* a numbering scheme. If now we read "x_{ij}" not as a numerical coëfficient but as the *proposition* that i stands in the relation x to j (which, indeed, it becomes through the suppression of "> 0" in "$x_{ij} > 0$"), the propositions "$\Sigma_i x_{ij}$," "$\Pi_i \Sigma_j x_{ij}$," etc. become assimilated to modern quantified propositions in which "Σ_i" and "Π_i" are read "for some i" and "for every i." If we construe the symbols in the numerical equations (1) and (2) above in similar fashion, and take the numerical multiplication in the right member of (1) and the numerical addition in that of (2) as conjunction and disjunction, then (1) becomes the current definition of the relative product, while (2) provides a good definition, in modern terms, of relative addition. The reïnterpretation just now described was adopted by PEIRCE himself within two years, as shown by his article of 1885. Such then is the interesting evolution of modern quantification from the summations and productions of arithmetic.

In the paper of 1883 above discussed PEIRCE also introduces a method of expressing quantified propositions about relations in terms exclusively of the all-inclusive and empty relations (∞ and 0) and the operations of negation and relative addition and multiplication, without recourse to quantifiers. He shows namely that the propositions

$$\Pi_i \Pi_j x_{ij} \qquad \Pi_i \Sigma_j x_{ij} \qquad \Sigma_i \Pi_j x_{ij} \qquad \Sigma_i \Sigma_j x_{ij}$$

are expressed by the four propositions "$\infty \text{—}< y$" where y is taken respectively as

$$0 \dagger x \dagger 0 \qquad (0 \dagger x)\, \infty \qquad 0 \dagger x \infty \qquad \infty x\, \infty$$

while the respective denials are expressed by "$\infty \text{—}< y$" for the same values of y. Then rendering tacit the invariable prefix "$\infty \text{—}<$," PEIRCE arrives at the four relative products and sums themselves and their negations as expressions of the eight quantitative propositions about x.

It is curious to note that even in the paper of 1885, where quantification has attained its modern estate, PEIRCE still clings somewhat to the old notion of quantification as attaching to a term in isolation. Using "a" to mean *any* term, considered as intrinsically quantified universally for no matter what context, he defines the denial of a proposition x as "$x \text{—}< a$," *i.e.* "If x, then anything." Yet he has the machinery within the same paper for expressing the definiens in terms of valid and unconfused quantification, namely as "$\Pi_y (x \text{—}< y)$." His election

of the other course seems to have as its motive the deducibility of the properties of denial, *e.g.* the principle of contraposition, as special cases of various properties of implication, *e.g.* transitivity. Substantially the same end could have been achieved through defining the denial of x as "$\Pi_y(x -\!< y)$" or "$x -\!< \Pi_y y$," but the requisite manipulations would have been difficult for a pioneer in quantification technique. In PEIRCE's arrangement four principles of implication are taken as postulates for the whole calculus of propositions: the principles of the reflexivity and transitivity of implication, the principle of the permutability of antecedents, and PEIRCE's law (4): $[(x -\!< y) -\!< x] -\!< x$.

In this article PEIRCE sets forth the relationship between inclusion and implication, the two meanings of his copula "$-\!<$", in a different manner from hitherto. Regarding implication as the primary reading of the sign, he construes a class name "t", occurring as copuland, as an ambiguous proposition "It is a t." Thus an inclusion "$s -\!< t$" comes to be read, "If it is an s, it is a t"; we are apparently called upon to understand a tacit universal quantification relatively to the variable "it." The fog enveloping quantification had not yet cleared to the point of forcing PEIRCE to recognize inclusion as a connective distinct from material implication.

The Boolean exercise of elimination remains prominent. In the article under discussion PEIRCE sets forth an interesting and effective technique for eliminating given class terms or relation terms from variously quantified premisses.

In a verbose article of 1892 PEIRCE shows that the affirmative syllogism is governed by the transitivity and reflexivity of inclusion, and not, as traditionally supposed, by the principle of identity. He shows further that the remaining principles of syllogism are embraced in two properties of negation: that diversity is symmetrical and that "is not P" means "is diverse from every P." Such is the simplification afforded by a relational approach to syllogistic.

PEIRCE continues with an introduction to the logic of relatives, in which he argues that all relatives are capable of analysis in terms of the dyadic and triadic, since all relatives of higher degree are expressible as relative products of triadic relatives. Thus he analyzes the tetradic relative "giver of — to the punisher of — for —" as the relative product of the triadic relatives "giver of — to —" and "punisher of — for —." PEIRCE regards it as established, by this argument, that there are fundamentally but two kinds of relatives, the dyadic and the triadic, and goes so far as to draw conclusions thence regarding

(4) So named by Professor JAN LUKASIEWICZ of Warsaw.

the metaphysical categories. He appears to lose sight of the fact that tetradic relatives, etc., even though expressible as relative products of triadic relatives, do not thereby become triadic. The relative product of two triadic relatives is not a triadic relative, but something new, namely a tetradic relative; in a universe confined to dyadic and triadic relatives the relative multiplication of triadic relatives could yield no result whatever. PEIRCE's analysis is nevertheless of value in yielding a method for the systematic determination of relatives of higher degree in terms of combinations of triadic relatives.

In a paper of 1897 PEIRCE introduces a scheme of diagrams analogous to those of molecules in chemistry, whereby the one, two or three free tails of classes or dyadic or triadic relations are variously connected to form propositions. He so encircles various of the class and relation signs that quantification relatively to the connecting tails is shown by the directions in which the tails intersect the circles. As described earlier, relations of higher degree can be built up by joining triadic ones. Dyadic relations and monadic relations (= predicates), furthermore, can be rendered in the diagrams as degenerate triadic relations by carrying one or two tails of the latter back into themselves; " — is wise " thus means " — is identical with self and with something that is wise." In terms of triadic relations and the machinery of tails and circles, then, together with a constant triadic relation " — is neither — nor —" whose purpose it is to provide for negation and disjunction, PEIRCE is able to render any proposition diagrammatically. As the vehicle for the remainder of the paper however he uses the ordinary one-dimensional symbolism, whose superiority both in clarity and in facility of manipulation he recognizes.

In the course of the remaining developments PEIRCE treats *correspondence*, arguing from his definition that it is one-one and transitive and that of any two classes one is in such correspondence with part or all of the other. This leads him to the work of CANTOR, whose proof that $2^n > n$ he renders in a popular form. But PEIRCE's main concern in the paper is SCHRÖDER, whose preoccupation with the solution of logical equations as the *raison d'être* of mathematical logic PEIRCE decries and whose general solution of the logical equation PEIRCE shows to be vacuous. On the other hand he expresses satisfaction with SCHRÖDER's pentagrammatic notation, in which any given relation is described (but not uniquely determined, it should be noted) by these five classes: the elements bearing the relation to all elements of the universe, the elements bearing the relation to all save one, the corresponding two classes for the negative of the relation, and, finally, the residue of the universe. Although the device offers little promise in current logistic,

PEIRCE valued it because of the ease with which, in the solution of problems, the pentads of classes could be subjected to logical addition or multiplication one with another by logically adding or multiplying homologous places.

PEIRCE's treatment of the logic of relations concludes, so far as concerns the volume under review, with a non-symbolic paper of 1903 in which he classifies dyadic relations according to various principles of division and devises a grotesque scheme of Latin prefixes and compounds of prefixes to the end of a systematic nomenclature. One classification depends upon whether anything bears the relation to be classified, or its negative, or its converse, to every element in the universe; another depends upon whether or not the given relation is a species or a genus of identity or of diversity; a third has reference to the *spikes* of a relation, *i.e.* classes every member of which has the relation and its converse to members of the class. These and other *fundamenta divisionis* yield a rich but idle array of species, whose interrelationships of inclusion and exclusion PEIRCE examines.

The discussion has thus far been confined to those writings, three fourths of the volume, concerned strictly with the logical calculi. Among the remainder are two papers on the logic of number, the first of which (1881) contains what is still probably the best known systematization of the arithmetic of positive integers. He defines addition and multiplication by the well known recursion formulae in terms of 1 and the successor relation, and then proves the various commutative, associative and distributive laws on the basis of his definitions. Now widening his system to cover all integers, PEIRCE extends his previous proofs to the new generality, proves the invertibility of addition and defines subtraction as the inverse. He defines 0 as 1—1, derives its properties, and proves also that

$$(-x)y = -(xy) \quad \text{and} \quad x = -(-x).$$

The paper concludes with an analysis of *counting*, in terms of one-one relations and the positive integers.

The later paper on the subject, an unfinished article of 1898, begins by a philosophical discussion opposing the definition of mathematics as a science of quantity or as a science of pure time and space, and favoring a more Kantian definition turning upon methodology, specifically the reasoning through diagrammatization. PEIRCE continues with a discussion of series and their various types, and concludes the fragment after proving the principle of mathematical induction.

There remains some material of a more discursive or philosophical cast, which, along with the article of 1892 discussed earlier, would probably have been relegated to volume II were it not for a desire to keep the

volumes fairly uniform in size. The paper of 1885 already mentioned is partly of this nature, presenting as it does the principal one of the various trichotomies of signs delineated in volume II. *Icons*, *indices* and *tokens* (or symbols) are connected with their objects respectively by resemblance, by a real symptomatic dependence, and by an arbitrary convention on the part of the sign-using subject. Applying these notions to his logical calculus, PEIRCE classifies his operational signs and his ordinary propositional variables, class variables, etc. as tokens, his subscripts of quantification (apparent variables) as indices of tokens and his entire formulae as icons. This classification is significant for the notions of modern logic; real and apparent variables become radically distinguished on the semantic level, the former being construed as signs and the latter as signs of signs. The reviewer believes that those who have worried over the logical status of the apparent variable will find a degree of satisfaction in this distinction.

The volume contains several strictly mathematical pieces of little interest to logicians, namely three short notes on the now obsolete subject of quaternions and two on the closely related topic of multiple algebras in general. Mention might also be made of a brief note of 1900 representing the dying gasp of the actual infinitesimal. There is a somewhat oratorical review of SCHRÖDER (1896), containing little of specific nature not touched upon elsewhere in the volume. The book concludes with nine items by PEIRCE from the *Dictionary of Philosophy and Psychology* (1911).

The finished product obviously provides a one-sided basis for judging the editors' discrimination in the selection and rejection of material. The foregoing pages reflect the reviewer's conviction, however, that some idle or repetitious matter has been included which might better have been cast aside. For the rest, the above synopsis shows that there is a wealth of historically interesting material and a fair infusion of ideas of current importance as well.

The editorial aids to the reader are limited to a comment recommending to the technically untrained a certain departure from the chronological sequence, a list of topics classified according as they are of historical, general logical or general interest, the usual index, bibliographical footnotes supplementing PEIRCE's own, and some helpful footnotes giving comparative cross-references within the PEIRCE collection. An effort also appears to have been made to annotate the text in an explanatory way, but for the most part these footnotes have the shortcoming of elucidating the obvious points and giving the more obscure passages wide berth.

The editors have adopted the hyperscholarly policy of reproducing PEIRCE's writings to the letter, misprints and all, and then introducing

the corrections through the medium of footnotes. The reader is disconcerted, however, by the fact that the symbolic text abounds in further misprints to which no such corrections are appended. Which of these occurred in PEIRCE's originals and were transmitted on faith into the present volume by an editor discouraged of understanding the thus obscured text, and which of them are emergent with the volume itself and thus to be attributed to that inadvertence a modicum of which is perhaps inevitable in any such symbol-burdened book as this, is a further matter of scholarship upon which we shall not embark. What is of consequence is the obstacle with which such misprints present the reader. In order that he may be spared the need of puzzling over some of these as we have had to do, we presume here to list some of the more troublesome errata.

P. 54, l. 21, for "$p\ \infty$" read "p^{∞}"; l. 22, for "$\infty\ x$" read "∞^{x}". P. 60, prefix "†" and "‡" respectively to last two lines of page. P. 61, ll. 4-6, for "II" read "$\amalg$" throughout. P. 66, l. 25, for "x_2" read "x^2". P. 67, l. 19, order the chaos to read "$l^{\Delta x}-1$"; adjust end of l. 20 to read "$l^{\Delta x}$", and read left member of second equation following as "log $l^{\Delta x}$". P. 69, l. 16, elevate small "1" to level of small "u"; l. 18, depress large "u" to allign with "1". P. 70, l. 26, enlarge and depress "$l-1$", for it is not an exponent. P. 92, l. 12, for "$o x$" read "o^{x}". P. 99, l. 21, for "$i_{11}i_{12}$" read "$i_{11}, i_{12},$". P. 121, l. 16, for "contradiction" read "contraposition." P. 136, interchange left member of l. 24 with that of l. 25. P. 151, l. 9, for "l_s" read "ls"; l. 11, for "l_s" read "^{l}s"; l. 12, after "servant" supply "of —"; l. 13, for "l_{o_s}" read "l_{os}". P. 172, l. 12, instead of last "$\mathcal{J}$" read "I". P. 196, replace the debris constitutive of l. 17 by the expression (we shall spare our printer) meaning "o to the power {o to the power $[(l)_{ij} + (b)_{ij}]$}". P. 245, l. 11, second parentheses, for "$q_{\lambda i}$" read "$q_{\lambda j}$"; l. 17, for "$q_{\gamma i}$" read "$q_{\gamma i}$"; l. 19, for "Σ_q" read "Σ_x". P. 246, l. 2, for "k" read "κ". P. 247, l. 30, for second "r" read "$\bar{r}$". P. 308, l. 2, for "3" read "22". P. 316,l. 13, supply das hafter "with." P. 342, l. 11, instead of "%" write the sickle in which the context abounds. P. 382, penultimate line, for "in" read "am." P. 383, l. 3, for "A spike" read "A relation."

In about a third of the occurrences of the notation "x,y" for logical multiplication, a space has erroneously been inserted so as to produce "x, y", with the result that the comma tends to appear as a grammatical comma belonging to the context. If the reader keeps this tendency in mind, such passages will cause him little difficulty.

In the symbolism of pp. 141-143 the spacing is uniformly misleading. Note therefore that l. 14, p. 141 is intended to mean

$$A = (A : A) + (A : B) + (A : C) + (A : D) + (A : E) + \text{etc.}$$

The other lines are analogous.

In PEIRCE's reasoning, furthermore, there are technical slips of which the editors are unaware. The reader can convince himself of these errors by some easy manipulations. (1) A double mistake on p. 131, ll. 17-18, may be corrected by reading "$b = \infty \quad c = 0$" instead of "$b = c = 0$," and "$a = \infty \quad d = 0$" instead of "$a = d = \infty$." (2) The sentence below the middle of p. 147, "A cyclic relative of the first order and first degree contains all individual components of the form A : A," is false, for it follows from PEIRCE's general definition that *all* relatives are of first order and first degree and indeed of nth order and nth degree for every n. The middle of the quoted sentence should be changed to read: "first order and zero degree." (3) The entry entitled "*Fourth*" on p. 149 is fallacious. It becomes valid of we replace the words "also the first and second marks" by the following: "changing the first and second marks from | to $\smile$ or from — to $\asymp$ or conversely and then interchanging the two resulting marks."

Two further hints, also withheld by the editors, will facilitate the understanding of p. 245: (1) for "q_κ", in l. 22, the stricter reading is "κ"; (2) throughout this section (§ 5) the form "r_{xyz}" is used for what was rendered "r_{yxz}" in the preceding section.

Harvard University. WILLARD V. QUINE.

C. C. Hurst.—*The Mechanism of Creative Evolution.* XXI+365 p., front., and 199 figs. in text. New York, The Macmillan Company; Cambridge, England, The University Press. 1932. (Price, $6.00).

This book will have permanent historical value as a critical synthetic summary of the essential values of the genetical story of creative evolution. The discoveries of chromosomes and genes and their interrelations are as important in the progress of biology as the discoveries of atoms and electrons have been in that of physics. The genes are the units of the individual and the genetical species are the units of creative evolution. The genes are the bases of both structural and functional characters and are the foundations of human thought and action. These discoveries, the author states, have brought to man freedom from the obsession of overruling fate and responsibilities in the near and distant future for the control of his own destiny.

There is a brief historical setting for genetic biology in the introduction, and the historical data are prominent in the various chapters, though the method of presentation is explanatory and logical rather than historical. This, and the very natural emphasis placed by the author upon his own significant work and that of his British colleagues, results in some

important omissions of basic discoveries, such as that of SUTTON of the diploid composition of the zygote. A use of GOLDSCHMIDT's results on the interaction of genes in the chapter on genes and characters might have enriched and revealed more fully the origins and the importance of this concept.

The chapter on the smallest living organisms reviews the limited data for the gene hypothesis among the Protozoa and yeasts, in which chromosomes are evident, among bacteria and blue-green algae, in which genes, if present, are not organized in chromosomes, but exist in a free state, and among the viruses, in which particulate structure is apparent.

In the chapter on the mechanism of creative evolution the author reveals himself as a strictly orthodox Darwinian admitting the direct action of the environment in producing mutations and transmutations by cosmic radiations, and this qualified by a cautious " may be." The environment is otherwise merely the necessary milieu for the action of natural selection.

The book is a clear and well organized presentation of the major achievements in genetics, and an attempt to extend the gene concept to phylogeny, ontogeny, the origin of life, and to other major problems of biology.

August 3, 1933. C. A. KOFOID.

Charles Singer.—*The story of living things:* a short account of the evolution of the biological sciences. XXXV+572 pages, 194 illustrations. New York and London: HARPER & Brothers, 1931. Price, $5.00.

Dr. SINGER's book is a notably successful and useful achievement. Part I, the Older Biology, reviews the development of biological knowledge from the days of the Greeks to those of HARVEY. Part II describes the foundations of modern biology on the application of inductive philosophy to scientific study, on the development of the microscope and other tools, and on the analysis and classification of discoveries made possible by the joint efforts of the members of scientific societies as well as by the efforts of many individuals. Part III (nearly half the book) deals with the progress made during the past seventy or eighty years as Dr. SINGER sees this progress along seven main themes in contemporary biological study: cell and organism, essentials of vital activity, relativity of functions, biogenesis and its implications, development of the individual, sex, and the mechanism of heredity. In the first half of the book the specialist finds readily accessible a clearly presented, readable survey of the history of his subject. In addition to this survey the general reader finds correlated and integrated in the other half of the book much

scientific information that without such systematic treatment might well be difficult of access and of comprehension. For any reader the index of proper names supplementing the detailed table of contents makes the book useful for reference as a cyclopedia of the biological sciences.

Inevitably, as Dr. SINGER recognizes in his stimulating introduction on science and history, such a survey runs the risk of revealing its author's ignorance or of taking sides in "domestic differences." Although his own allegiance to the vitalist's philosophy as opposed to the mechanist's point of view is evident, he unhesitatingly points out apparent fallacies of argument or weakness and inadequacy in the evidence thus far adduced for various scientific theories, both for those which he accepts and for those which he does not. At the same time he avoids dogmatic assertion of his views. His discussion of HAECKEL's work and influence (pp. 480-484) is a typical instance of his fair and understanding criticism of a controversial subject. The necessity of presenting recent biological theories and of discussing the scientific evidence supporting them gives a depth and a philosophical range to this account that is less apparent in Dr. SINGER's previous book, *The Short History of Medicine*, to which this volume is in some degree supplementary. Here is indeed the story of living things, for Dr. SINGER makes very clear the tremendous importance of the study of living matter as part of a living whole and not simply as a laboratory specimen, thus emphasizing anew the fundamental significance of the biological sciences as the study of life itself. If only for this fact alone, this latter book is the more important of the two histories, though each has its special value and place in the history of science.

An outstanding characteristic of Dr. SINGER's books and especially of this *Story of Living Things* is the evidence they give in style, allusion, quotation and illustration of the range and wealth of Dr. SINGER's culture and of his enthusiasm for his subject. This may be shown by an incidental reference to the origin of a term or a name as "fuchsia" (p. 88), or the Arabic "nucha" (p. 86), or it may be reflected in a careful discussion of the influence of KANT, GOETHE and OKEN upon scientific thought. Repeatedly references to texts and editions reflect Dr. SINGER's bibliographical learning and the good use he has made of his own collection of rare books in his chosen field. The sources for his illustrations and diagrams range from mediaeval carvings and illuminated manuscripts to the latest scientific monographs.

It is to be regretted, however, that Dr. SINGER in citing his sources does not give specific page references either for these illustrations or for the many passages from scientific works that he has appropriately quoted. On the whole the book is remarkably free from minor errors,

typographical or otherwise,—in itself an achievement in view of its range and cyclopedic character.

To the reviewer, an historian and student of the history of science whose training in biology was received more than twenty years ago, Dr. SINGER's lucid account of the contemporary developments in the biological sciences is particularly interesting because of the great amount of work he describes now being done along many lines and especially in the study of the cell and of the mechanisms of heredity. A new appreciation of the value and significance of these studies is gained when they are presented with the historical perspective this Short Account provides. Though biologists of various schools of thought may find cause for debate with Dr. SINGER, they and the general reader together with students of the history of science have reason to be grateful to him for making available in fluent lucid English and within reasonable compass this ordered presentation of a major field in the history of science.

Goucher College DOROTHY STIMSON.
Sept. 13, 1933.

Skinner, Constance Lindsay.—*Beaver, kings and cabins.* 273 p., 31 figs. and maps in text. New York, The MACMILLAN Co., 1933. Price $2.50.

The underlying purpose of this book is the tracing of the influence of the fur trade on the political history of North America. It also deals with the effects which this primitive field of exploitation of the native fauna and of native peoples have had on the exploration of the continent. The beaver has occupied the commanding position in this fur trade because of the quantity and quality of its fur and its wide use in beaver hats. The distribution of this fur-bearing mammal along the main watercourses and drainage systems has facilitated both transportation and has thus guided the course of history. It thus was instrumental in determining the destiny of North America north of Mexico, and influenced the localities and rate of development.

The fineness of the fur, the strength of the skin, the wide distribution of the species, and its marketability in the marts of the world made the beaver pelt the standard of barter among Indian tribes and the standard currency of the fur trade. The trade began as an offshoot of the cod fisheries, which involved shore stations and friendly relations with the adjacent Indian tribes who were covetous of the knives of the fishermen and bartered their finest furs for them.

In time this trade stirred up the intense and bloody rivalry of the French and the English. It bred a hardy race of *coureurs-de-bois*, partly of French-Indian and partly of Scotch-Indian extraction, who traversed

all the waterways and trails, and opened the way for exploration and settlement. The explorations of LEWIS and CLARKE, the pioneer outpost at Astoria, and the growth of the great Hudson Bay Company, all followed in the train of the fur trade. The lure of this trade, combined with the search for the even more valuable sea-otter, brought VANCOUVER and the Russians to the north-western shores of America and urged the Spaniards on their northward trek, even to Puget Sound.

The author might have added a chapter on the contributions to the sciences other than geographical exploration which have indirectly flowed from the fur trade, but this would have carried her into a different field where the names of RICHARDSON, DOUGLAS, CHAMISSO, ESCHRICHT, and ESCHSCHOLTZ shine.

December 12, 1933. C. A. KOFOID.

Fifty years' progress of American Ornithology, 1883-1933.—Published by the American Ornithologists' Union on the occasion of its Semi-Centennial Anniversary. New York, N. Y., November 13-16, 1933. 249 p., frontispiece. Lancaster, Pa. 1933.

This book contains a series of papers, the first of which is a history of the organization and progress of the American Ornithologists' Union by T. S. PALMER. The Union was organized in 1883 with 23 founders and 47 charter members. Its total membership, including associate, active, foreign, and corresponding members, in 1932 was 2036. It publishes " The Auk " and an occasional " Check-List " and " Code." WITMER STONE reviews the ornithological literature of the period. Over 20.000 items by American ornithologists have been published in the half century. The major contributions are noted by the geographical regions and treated by topic, with a note on the major bibliographies. WILLIAM ROWAN reviews the contributions to the field of bird migration. The work of the Union's Committee (1883) on bird migration was later (1885) transferred to the U. S. Department of Agriculture and the transfer was a factor in the establishment of the Division of Economic Ornithology and Mammalogy, later expanded into the Bureau of Biological Survey.

Mr. F. C. LINCOLN writes the history of the bird banding movement, the first instance of which is recorded by PLINY, who tells of a Roman sportsman who released birds at Volterra, marked with the colors of the winners of the chariot races, to carry the news to Rome. In 1908 WATSON used stained plumage in his investigations of the homing instinct of Sooty Terns. The first recorded instance of the marking of birds by metallic rings on the tarsus is that of a heron captured in Germany in 1710 with several rings on its tarsus, one of which had been attached in Turkey. AUDUBON used silver rings on Phoebes in 1803. The

modern movement was started by BARTSCH in 1902-03 on 101 fledgling Night Herons. The first general plan was suggested by COLE in 1902 on the analogy of fish tagging. The practice has now grown to such an extent that the reports of birds banded with U. S. Biological Survey bands had reached the number of 1.381.609 by 1933, with valuable results on migration, flyways, homing, life history, and population problems.

The theory of territorialism and its development and interpretation is treated by MARGARET MORSE NICE. The function of territory is that it spaces the breeding pairs so as to insure food for the brood. This is effected by the male becoming intolerant of other males within his area. The facts of this hypothesis were suggested by NAUMANN (1820) and ALTUM (1868). SHERMAN (1910) reported the phenomenon for the nesting Flicker and A. A. ALLEN (1914) for the Red-winged Blackbird. MOUSLEY (1919,1921) demonstrated that the male selects the locality before the arrival of the female and proclaims his ownership from his "Singing Tree." The credit for putting "Territorialism" on the bird map goes to HOWARD, who in his "British Warblers" (1907-1914) and especially in his "Territory in Bird Life" (1920), synthesized the scattered observations into a stereotyped analysis of bird behavior.

HERBERT FRIEDMANN reviews the outstanding examples of so-called life history work, in reality a mixture of the ecology and ethology of birds and W. L. MCATEE traces the growth of Economic Ornithology in the United States. This modern movement began with the analytical paper of S. A. FORBES (1880) "On Some Significant Interactions of Organisms," which was the beginning of a long series of studies of the interrelations of birds and insects, shared in largely by the U. S. Biological Survey, and resulting in legislation for the protection of most of the avian fauna.

Research and exhibition collections of birds in the United States in public and private ownership are summarized respectively, with statistics of their extent and contents, by J. L. PETERS and F. M. CHAPMAN. Mr. A. O. GROSS traces the applications of photography to ornithological investigations from the isolated successes of early workers to the scientific developments of HERRICK in his "Home Life of Wild Birds" (1901-1905), DUGMORE (1902), the extensive work of the FINLEYS, MCCLINTOCK, CLEAVES, JOB, BENT, ALLEN, color motion pictures by NEBLETTE, and sound motion pictures by BRAND and ALLEN.

The work of bird artists from AUDUBON to FUERTES and BROOKS is described by S. M. SUTTON. T. G. PEARSON reviews bird legislation, both Federal and State, largely fostered by the Ornithologists' Union and its members. The U. S. Government, mainly through the Bureau

of Biological Survey, has published since 1884, in the interests of the economic relations of birds and legislation to protect them, no less than 476 public documents in 27.448.000 copies containing 674.864.000 pages.

The facilities for education in ornithology in the United States are summarized by A. A. ALLEN and a resumé of investigations on American fossil birds is given by A. WETMORE. An appendix lists the presidents of the Union and the prominent features of their administrations. The book as a whole is an outstanding demonstration of the scientific and historical value of a closely knit group whose solidarity has given continuity and direction to the development of ornithological investigations in the United States unparalleled in other countries. This isolation of ornithologists from other fields of biology has, however, held them aloof from other movements in biological thought, as for example in genetics, and quantitative ecology, and it has yielded but slowly to the invasions from the fields of comparative psychology and endocrinology, all of which are basic to scientific ornithology.

CHARLES A. KOFOID.

P. Fournier.—*Voyages et découvertes scientifiques des missionaires naturalistes français à travers le monde pendant cinq siècles* (XV^e^ à XX^e^ siècles). *Encyc. Biol.* Vol. X. 108+258 p., 2 figs. and 30 portraits. Paris, PAUL LECHEVALIER & Fils, 1932. (80 francs).

Part I of this book deals with the voyageur-naturalistes of the French clergy prior to the Revolution, and Part II with the contributions of French missionaries to the progress of the natural sciences in the 19th and 20th centuries. The first part deals with the period when the French clergy were more eminent as explorers that as colonizing missionaries. Earliest in the field was ANDRÉ THÉVET, the Franciscan, who was the first to bring to Europe from the ephemeral "France antarctique" in Brazil the seeds of *Nicotiana tabacum* and the account of its uses and properties other than fiscal! JEAN NICOT later brought Floridan *N. rustica* from Portugal and LINNAEUS embalmed his name in that of the genus. Father HENNEPIN's *Description de la Louisiane* (1683) brought to Europe a full account of the buffalo and much Indian lore. The Jesuit explorer MARQUETTE increased the knowledge of American natural history, while the Jesuit *Relations de la Nouvelle France* (1632-1672) and the *Lettres édifiantes*, published over a period of fifty years, constitute additional sources. JEAN-BAPTISTE DU TERTRE in his *Histoire générale des Isles* (1654) contributed to the knowledge of the natural products and ethnography of the Antilles, and claimed that his work was pirated by ROCHEFORT in his *Histoire naturelle des Antilles* (1658). The Jesuit TAFUR, missionary to Peru, is given credit for the introduction of the

poudre des Jésuites, or quinine, into Europe about 1650 (see CANEZA, *Pulvis Jesuiticus*, Rome, 1925). The claim that they also introduced the Dindon, or turkey, has no historic authentication.

French missionaries were late in arrival in the Orient, but were quickly productive of an extensive literature. LE FÈVRE was in the astronomical bureau in Pekin in the middle of the 17th century. The mission to Siam and China in 1658 was noted for its scientific enterprise, a pattern followed to this day by the Jesuits in China. LE COMTE (1655-1728) introduced the Chinese orange into Portugal, introduced tobacco to Pekin, and reported on the soybean of Manchuria. DENTRECOLLES (1727) wrote of the persimmon and lichi, and translated from the Chinese treatises on the silkworm. He also reported, twenty years before the birth of JENNER, a mode of vaccination current in China, using dried scabs in the nasal tract.

In the 18th century LAFITAU discovered (1718) the American ginseng, and prepared a very complete ethnology in his *Mœurs des Ameriquains* (1724). CHARLEVOIX (1744) described ninety-eight species of Canadian plants, with a binomial nomenclature, nine years before the *Species* of LINNAEUS.

Of all the early naturalists the most brilliant was CHARLES PLUMIER (1646-1704), *princeps botanicorum*, engraver of his own superb plates, the pre-Linnean botanical explorer of the West Indies. He left 6,000 drawings, including 1,200 of animals, in twenty folios, which were dispersed among the libraries of Europe. His *Plants of America* (1693) was published by the state, and contained 705 species. His *Nova Plantarum* (1703) described 103 new genera, and his *Fougères de l'Amérique* figured 180 species. He was thus the veritable founder of American tropical botany. His work was incorporated by LINNAEUS in his first edition of his *Species*. Under the laws of botanical nomenclature all of PLUMIER's names, which were not cast in the rigid form of the Binomial System, give way to those of the founder of that system. PLUMIER's work is respected for its accuracy, the beauty of his plates, and the enterprise and thoroughness of his explorations. To him is also given the credit of distinguishing the cochineal insect as not a botanical product.

The second part of the book is a biographical catalogue of the missionary naturalists, making a total of four hundred names, with a bibliography for each of their scientific contributions.

The whole makes an imposing array, ranging from ethnological contributions in *L'Anthropos* to monographs in all phases of natural history, medicine, geology, and seismology. The high level of culture of the personnel, the prolonged residence, wide travels, and intimate contacts

resulting from the nature of their primary enterprise, the continuity and localization of the missionary movement, with its centralized system of records, the outstanding examples of scientific eminence from the earliest days within the several orders of the Church, and the devotion of the individual workers, all underlie this scientific movement. In its volume and thoroughness it surpasses that arising from political sources and industrial enterprises associated with colonial expansion.

The work is splendidly documented and the citations and annotations are skillfully made. The bibliographies include unpublished manuscripts and drawings in the archives of the orders of the Church.

August 14, 1933. CHARLES A. KOFOID.

Charles O. Paullin.—*Atlas of the historical geography of the United States*, by CHARLES O. PAULLIN, Carnegie Institution of Washington. Edited by JOHN K. WRIGHT, Librarian, American Geographical Society of New York. Published jointly by (the) Carnegie Institution of Washington and the American Geographical Society of New York. XIV+162 pp., with detailed index of 14 pages; 166 plates, 1932.

The Loubat prize of $ 1000, presented every five years for the " best work printed and published in the English language on the history, geography, ethnology, philology or numismatics of North America " was awarded in April (*New York Times*, April 11, 1933) to Dr. C. O. PAULLIN and Dr. JOHN K. WRIGHT for this work.

The title of this handsome volume suggests to the student of the history of science a work mainly occupied with historical cartography, touching particularly the historical evolution of the United States in maps. The aim is stated on page XI to be " to illustrate cartographically, in manageable compass, and yet with considerable detail, essential facts of geography and history that condition and explain the development of the United States."

Undoubtedly the time has come when scientists should agree upon a terminology so that the title of so important a work as this should really indicate to competent scholars the nature of its contents. The use of " cartographically " in the important statement of the aim is new to the reviewer who has been occupied with historical cartography for many years.

Doubtless the geographer has some right in considering that the phrase " historical geography " refers to those topics which American geographers consider their field. In consequence this particular " atlas of historical geography " of the United States begins by giving seven plates, touching natural environments and topics as diverse as glaciated

areas, cultivated crops, winds and sailing routes, soil regions, vegetation regions and climate, as a background for the study of those developments which may be termed " geographical."

Noteworthy treatment is given to the problems of the development of settled areas, colonial towns, and modern cities and political boundaries. The historical discussion of population groups, with the illuminating pictorial representation, will be useful for many who do not consider themselves " geographers." Similarly the treatment of " colleges, universities and churches," which to Europeans may appear an amazing group, will prove of wide interest to those who wish seriously to study the intellectual development of the United States.

In connection with international, colonial and state boundary lines, maps are presented giving the drainage and geographical features, as well as claimed, proposed and agreed upon boundaries. The organization and presentation of the boundary discussions gives an enormous amount of material, suggestive in many instances of the necessity for further detailed research in the field. Cartographically and in almost every point of view the treatment of boundary disputes is comprehensive and highly satisfactory.

The inclusion of " political parties and opinions," and " political, social, and educational reforms," indicates how wide an application these authors have made of the term " historical geography." In any event the graphical treatment will be found very suggestive and illuminating by those scientists who consider these topics their particular field of investigation. The same statement may be made with regard to " Military History," certainly not definitely a geographical topic; the approach here is intended to be from the geographical conditions determining in some measure the campaigns and possibly geographical after-effects.

Certainly the part of " foreign commerce " and " industry and transportation " in the historical development of the United States cannot be overestimated. One may dispute however the distribution of attention in a historical geographical atlas, which gives in such a work to " political parties and opinion " and " to political social and educational reforms " a total of 43 pages with 42 full pages of plates, while " Industry and Transportation " receive 6 pages of text and 12 full pages of plates and " foreign commerce " is dismissed with about one page of text and no plates.

The discussion above indicates the somewhat strange mixture of material, undoubtedly largely having geographical implications, which may be found within the covers of this scholarly contribution to reference material on the development of these United States.

So far as historical cartography is concerned there is a wealth of fine reproduction of important maps relating to the appearance of the United States areas upon the map. The sponsors of this volume would not claim, I am sure, that there is given here in pages 7 to 15 nor in the subsequent material, any adequate systematic discussion of this phase of an atlas of historical geography.

The task of making a real historical atlas of the cartographical development of the United States upon the map remains for serious systematic treatment. No recognized student of cartography like HEAWOOD of London or WIEDER of Holland compiled this series of maps. It would only be worth while to criticize the details of the historical cartography in this work if the material were the result of the efforts of some qualified student of this subject.

I may mention that the statement, " In dating maps the best authorities were followed " is questionable; this touches very difficult problems. Concerning MERCATOR's great world map of 1569 it is decidedly misleading to state that " there is a hint of the Great Lakes in the fresh-water sea and the three small lakes near thereto "; this was the precise attempt of a great cartographer to definitely indicate the material given by CARTIER. It is possibly unfortunate to designate DELISLE's great maps as " loose " and it is quite unnecessary to mention that these are found in bound collections of DELISLE's maps. It is entirely inadequate to state that " in many respects the DELISLE Map is an improvement on earlier maps " and the rest as given (p. 12). The most important cartographical point is that with DELISLE and his great teacher, the astronomer GIOVANNI DOMENICO CASSINI, begins the scientific use of astronomical observations of the moons of Jupiter for the determination of correct longitudes. With CASSINI's world map of 1696 and DELISLE's maps of 1700 begins scientific cartography, because they practically alone of cartographers in their day courageously accepted the determinations of the astronomers and coupled these with the widest use of the original accounts of exploreres and colonizers. The DELISLE maps are the product of science seriously applied to cartographical problems. The DELISLE maps of 1700 mark an epoch not so much in American cartography as in world cartography and correct longitudes, but in 1703 the more complete application to American cartography was made; in the interval between those dates DELISLE made systematic study of the accounts of America, particularly of Canada, available in the offices of the Minister of Colonies and possibly the Minister of Marine.

Doubtless the omission of the names of JEDIDIAH MORSE and the S. AUGUSTUS MITCHELLS, Senior and Junior, must occasion most surprise to any who are at all familiar with the history of geography in America.

JEDIDIAH MORSE was the author of the first American geography (New Haven 1784) and the most prolific writer on geography in the period from 1784 to 1826; indeed his text-books continued in use for many years after his death. The S. AUGUSTUS MITCHELL and S. A. MITCHELL, Jr. maps and text-books represent undoubtedly the most widely used geographical material in the period from 1840 to 1870. The one covers the period directly after the Revolutionary War and the other covers the Civil War Period.

Despite any criticisms implied in the above remarks American scholars have many reasons to be proud of this noble volume by PAULLIN and WRIGHT. These gentlemen have thru their labor given to scholars an enormous amount of useful material, with a graphical treatment which shows the tremendous power of that instrument. The organizations involved in its presentation to the scholarly public of the world have every reason to congratulate themselves upon their achievement, a real monument to American scholarship.

Ann Arbor, Michigan. LOUIS C. KARPINSKI.
June 5, 1933.

The founder of lake-dwelling archaeology.—GEROLD MEYER VON KNONAU: Lebensabriss des... Dr. FERDINAND KELLER (Denkschrift zur fünfzigjährigen Stiftungsfeier der Antiquarischen Gesellschaft in Zürich, S. 1-39, 2 Bildn., Zürich, Druck von DAVID BÜRKLI, 1882).

ANTON LARGIADÈR: Aus dem Briefwechsel FERDINAND KELLERS (Festgabe HANS LEHMANN, XXXI+162 S., Zürich, Antiquarische Gesellschaft, 1931).

ANTON LARGIADÈR: Hundert Jahre Antiquarische Gesellschaft in Zürich (VIII+301 S., 3 Bildn., Zürich, Antiquarische Gesellschaft, 1932).

These three precious volumes which I owe to the kindness of Frau HORBER-GULL and of Dr. HANS LEHMANN—who as president of the *Antiquarische Gesellschaft* continues in a worthy manner glorious traditions—give me a very welcome opportunity of celebrating the memory of FERDINAND KELLER, the founder of one of the most interesting branches of prehistoric research.

(JOHANN) FERDINAND KELLER was born in Marthalen (Canton Zurich) on Dec. 24, 1800. He belonged to one of the oldest Zurich families. One JOHANNES KELLER was burgomaster of that city in 1445. FERDINAND's father, HEINRICH KELLER, was a goldsmith; his mother ANNA HABLÜTZEL, came from Trüllikon. His father was a good representative of the city bourgeoisie, and his mother of the rural one. FERDINAND was

educated in Winterthur and Zurich, then traveled to Lausanne and Paris, and became private tutor in the family of an English member of parliament, HENRY SEYMOUR. In that capacity he spent a few years in London and in the English country. He attended the inauguration of the Liverpool-Manchester railway and from that time on suffered from a liver complaint. He returned to Switzerland in 1831 hoping to recover. He had planned to go back to England but remained in his own country, teaching English, and engaging in various kinds of local investigations. For a time his main interest was natural history, but the discovery of various antiquities turned his mind more and more to archaeology and he was the founder in 1832 of the local archaeological society, which was first called " Gesellschaft für vaterländische Alterthümer." In this KELLER was certainly influenced by his English experiences. Thereafter he devoted most of his time to archaeological research and thanks to his inspiration and energy, and the warm coöperation of a small group of enlightened Züricher, that society became one of the most active and influential antiquarian societies of Europe. The interests of the Zurich society were very broad: everything relative to the past of their beloved city, whether pre-Roman, Roman, mediaeval or of a later time—concerned them, and KELLER's curiosity covered the whole ground.

The results of their investigations were largely of local or national interest, but a discovery made in the winter of 1853-54 started a new field of research which interested the whole world. That winter was exceptionally cold, and the waters of the Lake of Zurich sank to a lower level than any previously on record. Some inhabitants of Ober-Meilen took advantage of this to increase their vineyards by enclosing portions of the exposed shore and filling them up. In the course of these operations they unearthed various objects such as portions of rotten timber, stone axes, flint implements—of which the local schoolmaster, named AEPPLI, realized the human connections. He brought these tidings to Zurich in January 1854. KELLER came to examine the objects and realized at once their importance. Within that same year 1854, he published his first report on the subject, entitled " *Die keltischen* (1) *Pfahlbauten in den Schweizerseen.*" The word *Pfahlbauten* was here used I believe for the first time, and at any rate that report was the opening chapter of a new branch of prehistoric research. KELLER suggested that the other lakes of Switzerland be examined with regard to the possibility of finding the remains of other lake-dwellings. His appeal was heeded by many archaeologists, and in his second report (1858) he was already

(1) The misleading word " keltischen " appeared only in this first report.

able to speak of various other investigations in other places. It was already clear to him that there were lake-dwellings of different periods, and that the oldest, dating from the stone age, showed already evidence of a relatively high stage of husbandry and culture. Other lake dwellings date from the Bronze age, the Iron age, and some had probably continued to exist under Roman sovereignty. KELLER's later reports were really general surveys of all lacustrine investigations which became more and more abundant as time went by; they appeared in 1860, 1861, 1863 and 1866.

Owing to their gradual publication, these six reports contained repetitions and contradictions, and as their mass increased the study of the subject became more and more difficult. At this juncture, an English antiquarian and geologist, JOHN EDWARD LEE (2), appeared and undertook not only to translate KELLER's reports but to redigest and rearrange them under the author's direction. That English version entitled *Lake-dwellings of Switzerland and other parts of Europe* (x+424 p., 98 pl.) was published in London 1866. After the publication of KELLER's seventh report, LEE published a second edition of his work greatly enlarged (2 vols. 725 p., 206 pl., London 1878).

In the meanwhile many other investigators had entered this promising field and there were already a sufficient number of publications on lake-dwellings to enable one to speak of a " literature " on the subject. See for instance the bibliography appended to ROBERT MUNRO : *The lake-dwellings of Europe* (London 1890) wherein 469 items are arranged in chronological order starting from 1822 to 1890 (328 down to 1878). The publications anterior to KELLER's first one (1854) deal chiefly with Irish and Scotch *crannogs*—and that was a somewhat different story. The crannogs were stockaded islands; they were fascine-dwellings rather than pile-dwellings; and as a group they represented a later type of culture than the lake-dwellings of central Europe. The latter are neolithic or of the Bronze age, and they marked the transition to the Iron age; the crannogs on the other hand marked the transition from the Iron age to historic times and there are many references to them in the Irish and Scotch annals, even as late as the beginning of the seventeenth century.

By the way, the earliest references to lake-dwellings date from the fifth century B.C. : they may be found in HERODOTOS and HIPPOCRATES (3). Yet we may say that KELLER was the true father of lake-dwelling archaeology, for he did not simply recognize their existence

(2) Born at Hull 1808; died in Torquay 1887. (DNB, 32, 363).
(3) SARTON : *Introduction* (1, 105).

but realized at once their importance, spent a good part of his life investigating them and promoting other investigations, and finally wrote a long series of reports which stimulated and guided the growth of this new branch of knowledge. He published his eighth and last report in 1879, and died in Zurich on July 21, 1881. The golden jubilee of the *Antiquarische Gesellschaft* and the memory of its founder were celebrated in the following year.

It is not necessary to dwell longer on the value of KELLER's pioneer activities and of the development which this branch of prehistoric research has taken within less than eighty years. Witness the museum of Zurich (also in a sense one of KELLER's foundations), and many other Swiss and European museums, and abundant publications of all kinds. I should like to mention only two more. ROBERT MUNRO: A sketch of lake-dwelling research (*Proceedings of the Royal Society of Edinburgh*, vol. 20, 385-411, 1895) and the article "Pfahlbau" in MAX EBERT's *Reallexikon der Vorgeschichte* (15 vols., Berlin, 1924-32; vol. 10, 85-102).

It is meet to pay homage to KELLER's memory in *Isis* and I am glad that the *Antiquarische Gesellschaft* of Zurich gave me the gracious permission to reproduce here (see frontispiece of this number) one of his portraits. (4) Indeed this will help our readers—especially the scientists *stricto sensu*—to realize the existence and pregnancy of archaeological research, a discipline which has completely revolutionized the conception and methods of history within less than a century; we might almost say within half a century, for we have witnessed recently immense progress not only in our knowledge but in its diffusion. The old fashioned conception of history, as an activity much closer to literature than to science, has been gradually replaced by a very different one, and the historian has become a brother of the geologist. The archaeologists have succeeded in building up a bridge between science and history, and we are deeply interested in their efforts because we—historians of science—are trying to do the same. We may be encouraged by their success,—but we shall do well to remember that they only succeeded because of their correct and constant application of sound scientific principles to their task. The history of science will be recognized as a new branch of knowledge as soon as it ceases to be mere dilettantism and becomes in fact a scientific discipline:—then, and then only, will it become the new bridge we are dreaming of. For how could a bridge be built—and especially such a gigantic one—without solid foundations?

GEORGE SARTON.

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(4) Originally published in the *Denkschrift* of 1882.

Henry Harris.—*California's Medical Story.* With an Introduction by CHARLES SINGER. The Grabhorn Press for J. W. STACEY, Inc., San Francisco, 1932. xx+421 pp., 28 illus. $ 3.50.

Of all the many recent histories of medicine of a local American area this is the most attractively organized and written and the most beautifully printed that I have examined. In his interesting introduction justifying current emphasis on "local" histories, Professor SINGER says, "For the study of medical history, California presents quite exceptional advantages. The geographical isolation of its population makes a true local study more valid than would be the case for most states. The earlier records have been better and more lovingly preserved in California than in any other civilization that has developed so recently and so rapidly. The presence of first class library facilities is unique for so youthful an aggregate. The very rapid evolution of California civilization has carried with it a no less rapid evolution of medicine from the primitive and magical age to the highly scientific, though no less human, discipline which is enabling the medical schools of the State to provide as well equipped medical men as are to be found anywhere in the world. Thus Californian Medicine is an almost ideal field for the story of local history. The broad conception, the painstaking and thorough investigation, and the attractive presentation of the work of Dr. HARRIS do justice to his theme. He has prepared a model local history. When more such works become available a true inductive history of modern medicine will become possible."

Dr. HARRIS has conveniently arranged his material in sections as follows: I. *The Medicine of the California Indian*: Making of the Shaman; Principles and Practice; Therapeutics and Prophylaxis; Specialization of Shamans; Contributions to Therapy; II. *Spanish Period* (1769-1822): Introduction of the White Man's Medicine; The Surgeon-Generals at Monterey; Visiting Scientists; III. *Mexican Period* (1822-1846): California and Mexico; Doctor Adventurers; Domestic Medicine and Lay Practitioners; IV. *American Period-Acquisition* (1846-1850): Military Occupation; Gold Fever; Doctors of the Gold Fever Time; V. *American Period-Organization* (1850-1875): Early Health Measures, Local and State; Early Hospitals; Insanity and Insane Asylums; Rise and Fall of Local Medical Societies; The Two Pioneer Medical Schools (Medical Department of the University of the Pacific, 1858-1864, reorganized as the Medical College of the Pacific, 1870-1882, as COOPER Medical College, 1882-1912, and thence as Stanford University Medical School; TOLAND Medical College, founded 1864 which became the Medical Department of the University of California in 1873); Early Medical Press; California State Medical Society (1856); California State Board

of Health (1870); Triad of Quackery, Medical Education and Medical Legislation; Medical Practice Law (1876); The Personal Side; VI. *American Period-Progress* (1875-1900); Expansion; Homeopathy and Eclecticism; Early Examining Boards; Medical Women in California; The Trained Nurse; Emergence of Southern California; Climate; Later Medical Organizations; Later Medical Press; VII. *American Period-Practice* (1875-1900): City and Country Practice; The Plague (1900); Changes in Materia Medica and the Apothecary Shop; Specialization in the Healing Arts and Sciences; Aberrant Systems; Public Health and Social Medicine; California Medicine Writes its History; VIII. *Biography:* V. L. FOURGEAUD, 1815-1875 (His *Prospects of California*, 1848, enticed many easterners to California, even before his essay of MARSHALL's gold found on the American River in 1848 helped inaugurate the gold rush. His *Diphtheria*, 1856, is significant, as his *History of Medicine* in the *Pacific Medical and Surgical Journal* of 1863 is interesting); JAMES BLAKE, 1815-1893, an intriguing pioneer English pharmacologist who first attempted (1839 *et seq.*) to show a relationship between chemical constitution and physiological action, a gold rush physician, who advocated the open air rest treatment of tuberculosis as early as 1862, and an important California scientific contributor to chemistry, geology, mineralogy, zoology, physiology, meteorology, and archeology; HENRY GIBBONS, 1808-1884, pioneer medical editor and organizer, a Quaker reformer, and ardent botanist and climatologist; R. BEVERLY COLE, 1829-1901, colorful obstetrician and medical politician; H. H. TOLAND, 1806-1880, surgeon and medical educator; E. S. COOPER, 1822-1862, surgeon; LEVI COOPER LANE, 1830-1902, who performed America's first vaginal hysterectomy, and who was the scholarly founder of the Lane Medical Lectures (1895) and the Lane Medical Library; J. F. MORSE, 1815-1874; J. B. PIGNE-DUPUYTREN, 1806-1886; N. J. MARTINACHE, 1833-1892; W. E. EICHELROTH, 1824-1896; E. A. KINKLER, 1808-1881; H. H. BEHR, 1818-1904; F. VON LOEHR, 1817-1876, and CEPHAS L. BARD, 1843-1902, who recorded the history of medicine in Southern California. A bibliography and index close the volume.

Since Dr. HARRIS' study does not presume to include California medicine since 1900, it naturally places most emphasis on the richly flavored but scientifically unsubstantial events of the post gold rush and flush silver period. This factor, combined with Dr. HARRIS' flashing but sometimes facetious wit, tends to minimize recognition of many of California's real scientific contributions to medicine, especially the more recent ones. Thus the great influence of JACQUES LOEB (1859-1929), who was Professor of Physiology at the University of California from 1902 to 1910, is not hinted at, nor can the reader suspect from

the mere mention of the Hooper Foundation for Medical Research at the University of California what a surprising amount of great work has come from its laboratories under the direction first of Dr. GEORGE WHIPPLE and later of Dr. F. MEYER. Again the significance of the Lane Medical Lectures cannot be appreciated without a full list of the lecturers and their subjects, the most important of which for the history of science being the series by Sir MICHAEL FOSTER on the *History of Physiology* (1901).

But Dr. HARRIS has given a brilliant account of the indigenous medicine of the California aborigenes, and he discusses masterfully the medicine of the Spanish and Mexican eras. The chief native contribution to medicine was "cascara sagrada" *(Rhamnus purshiana)*, given by the Indians to the Spaniards as a purgative. Among the native hygienic practices, usually ritualistic and magical as in other primitive communities, sweating was especially prominent. Unique was the custom of deliberately training from childhood a certain group of males for homosexual practices for the purpose of protecting the chastity of the unmarried women of the tribes.

The first resident doctor in California was Don PEDRO PRAT, Captain-Surgeon on the San Carlos which entered San Diego Bay in 1769 on the initial missionary-colonization enterprise of the Spaniards. He was later stationed at Monterey. His most formidable medical problem seemed to be scurvy. The Franciscans, who conducted the colonization of California, were not impressed by the advantages of knowledge or learning. The results of this attitude were reflected in the medical problems of the missions. Contact with the Spaniards brought phthisis, smallpox, measles, and venereal disease to the natives, with appalling mortality. Although contagion was recognized, with enforced isolation, and although even vaccination with native cowpox was tried (1786), the missionaries were powerless in the face of native indifference or resentment to curtail the decimation.

Dr. HARRIS' racy narrative of the coming of American doctors, of the gold fever period, and of the later organisation of California medicine must be read to be appreciated. Especially interesting is his account of the conflict between science and politics which arose with the plague outbreak in San Francisco's Chinatown in 1900. To his patience and skill in collecting and assembling his scattered material respectful credit is due. He has selected excellent illustrations which often better than descriptions give the atmosphere of the strenuous but frequently naive times upon which the current California scene is built. Dr. HARRIS has not neglected to give the contemporaneous background for the proper appreciation of his medical story, and this

is not the least of the many merits of his thoroughly delightful book.

C. D. LEAKE.

L'œuvre historique du Dr. Van Schevensteen. — **A. F. C. Van Schevensteen.** — La lèpre dans le marquisat d Anvers aux temps passés. Extrait du *Recueil des Mémoires couronnés, et autres Mémoires de l'Académie royale de Médecine de Belgique*, t. 24, 129 p., 4 pl., 1930.

Le Dr. VAN SCHEVENSTEEN, médecin en chef de l'Institut ophtalmique de la ville d'Anvers est l'un des principaux historiens de la science de Belgique. Après s'être occupé pendant longtemps de médecine pure (sa première publication médicale date de 1907), il commença à s'intéresser sérieusement à l'histoire en 1921 et fut avec le Dr. TRICOT-ROYER l'organisateur du premier Congrès de l'art de guérir tenu à Anvers en 1920 (voir *Liber memorialis*, 512 p., Anvers 1921). Depuis, il a publié un grand nombre de travaux historiques consacrés surtout à l'ophtalmologie, au folklore médical, à l'histoire des maladies et de la pratique médicale dans le pays d'Anvers. Notre bibliographie critique a souvent cité ces travaux, mais nous n'avons jamais eu l'occasion de les étudier, car l'auteur ignorait la revue *Isis* publiée si près de chez lui.

Nous sommes heureux de pouvoir réparer cette lacune. La présente étude basée sur des documents d'archives est fort intéressante car la lèpre (ou une pseudo-lèpre) a continué à être traitée à Anvers beaucoup plus longtemps que partout ailleurs, — jusqu'au début du XIX^{e} siècle ! Cette persistance ne peut s'expliquer que par une conspiration tacite et même inconsciente des médecins, des religieuses de Terzieken, et des mendiants (pseudo-lépreux) qui avaient intérêt à prolonger des conditions surannées ou qui étaient trop flèmards pour les modifier.

Pour les détails, je dois me borner à renvoyer au mémoire original qui se lit fort aisément en dépit de son érudition. Il est divisé comme suit : Sources. Histoire du couvent de Terzieken (fondé vers 1231). Les prébendiaires de Terzieken. Les lépreux agrestes, Dambrugge. Les statuts des lépreux. La visite des lépreux. Composition du jury d'examen. Les compléments de la visite. Les frais de la visite. Les incidents de la visite. L'assistance aux lépreux. La fréquence de la lèpre. La valeur séméiologique du vocable « lèpre ». Statistiques.

Je profite de cette occasion pour donner une liste des travaux historiques antérieurs de l'auteur :

1. Les préjugés et autres erreurs populaires relatives à l'ophtalmologie. *(I^{er} Congrès de l'art de guérir)*. Anvers, 1921, 14 pp. 2. Les pratiques religieuses dans le folklore médical oculaire en Belgique. *Ibid.* Anvers, 1921, 15 p. 3. Over folklore der bedevaarten voor ooglijders in Belgie. *Nederlandsch Tijdschrift voor Geneeskunde*, 1921, eerste helft, n^{o} 1,

Amsterdam, 8 pp. 4. Les plantes dans les maladies des yeux. *(II^e Congrès de l'Histoire de la Médecine)*. Paris, 1921, 27 pp. 5. Les remèdes d'origine humaine dans les maladies des yeux. *(III^e Congrès de l'histoire de la médecine)*. Londres, 1922, 15 pp. 6. The use of remedies of human origin in eye diseases. *The Pharmaceutical Journal and Pharmacist*, Oct. 28, 1922, London, 3 pp. 7. Bijdrage tot de bibliographie der brillen. *Nederlandsch Tijdschrift voor geneeskunde*, 1923, tweede helft, n° 16. Amsterdam, 3 pp. 8. A propos de traités d'ophtalmologie parus à Strasbourg au début du XVI^e siècle. *Janus*, janvier-février 1924, Leyde, 20 pp. 9. Répertoire des annonces médicales parues dans les journaux politiques dans les provinces belges aux XVII^e et XVIII^e siècles. *Yperman*, 1 et 2 (octobre-décembre 1923 et mars 1924). Anvers, 48 pp. 10. Une famille d'oculistes ambulants : Les SCHAUWERMANS (*V^e Congrès International des Sciences historiques*. Bruxelles, 1923), Anvers, 1924, 16 pp. 11. Un procès en contestation d'honoraires de l'oculiste CATHARINA SCHAUWERMANS. *Annales et Bulletin de la Société de Médecine d'Anvers*, juin 1924, 23 p. 12. Over kwakzalversstrooibriefjes in de XVI^e eeuw. *De Gulden Passer*. Antwerpen, nieuwe reeks, tweede jaargang, nr. 1, 14 pp. 13. Les oculistes ambulants dans les provinces belges aux XVII^e et XVIII^e siècles. *Recueil des Mémoires couronnés et autres Mémoires de l'Académie royale de médecine de Belgique*, t. 22, Bruxelles, 1924, 73 pp. 14. Contributions à l'iconographie des « Egerländer Amuletten ». *(V^e Congrès de l'histoire de la médecine)*. Genève, 1925, 12 pp., fig. 15. Het Archief van het Chirurgyns- en Barbiers-Ambacht. *Antwerpsch Archievenblad*, tweede reeks, eerste jaargang, Januari 1926, Antwerpen, 24 pp. 16. Les statuts du Collège de la Chirurgie à la fin de l'Ancien régime et l'état de la corporation des Chirurgiens-Barbiers à Anvers en 1784, *Bulletin de la Société française d'histoire de la médecine*, 20, 24 p., Paris, 1926. 17. Traité de l'usage des lunettes (de BOUDON, 1682). Réimpression avec commentaire bibliographique. Aubenas, 1926. 18. De leprozen en de stadsrekeningen van Antwerpen tot het einde van het oud regiem. *Bijdragen tot de geschiedenis*, achttiende jaargang, Januari-Maart, 1927, 50 pp. 19. De reglementeering der Leproosdij te Antwerpen. *Antwerpsch Archievenblad*, tweede reeks, tweede jaargang, tweede aflevering, April 1927, 22 pp. 20. De hygiënische maatregelen van het Magistraat van Antwerpen in de XV^e eeuw. *Nederlandsch Tijdschrift voor Geneeskunde*, 1927, eerste helft, 19. Amsterdam, 16 pp. 21. Une consultation de la Faculté de Médecine de Louvain au sujet de la lèpre à Anvers au début du XVIII^e siècle. *Janus*, juillet-août, 1927, 8 pp. 22. De rekeningen van het Klooster Terzieken te Antwerpen. *Bijdragen tot de geschiedenis*, achttiende jaargang, November-December 1927, 39 pp. 23. Les prescriptions hygiéniques et médicales à Anvers entre 1439

et 1496. *Annales de l'Académie royale d'Archéologie de Belgique*, 1927, 7e série, 4, 20 pp. 24. Les chirurgiens de l'Hôpital Sainte-Élisabeth à Anvers, jusqu'à la fin de l'Ancien Régime. *Mémoires couronnés et autres mémoires publiés par l'Académie royale de Médecine de Belgique*, t. 24, 5e facs., 1927, 43 pp. 25. De ontwikkeling van het Klooster Terzieken te Antwerpen. *Antwerpsch Archievenblad*, tweede reeks, derde jaargang, tweede aflevering, April 1928, 39 pp. 26. De visitatie-protokollen der Leprozen te Antwerpen. *Bijdragen tot de geschiedenis*, negentiende jaargang, juni-juli 1928, 23 pp. 27. A propos de l'article du Dr. TRICOT-ROYER. Un point d'histoire : Quelles étaient les affections qualifiées de lépreuses dans l'ancien duché de Brabant. *Janus*, 32, 1928, 6 pp. 28. De ondergang van het Klooster Terzieken binnen Antwerpen. *Bijdragen tot de geschiedenis*, negentiende jaargang, augustus-december, 1928, 46 pp. 29. Inventaire des comptes de l'Hôpital Sainte-Élisabeth à Anvers. *Bulletin de l'Académie royale d'Archéologie de Belgique*, 1927, Anvers, 1928, 12 pp. 30. De statuten van het Klooster Terzieken te Antwerpen. *Antwerpsch Archievenblad*, tweede reeks, vierde jaargang, 1929, 41e aflevering, januari, 25 pp. 31. Het proces van Terzieken met de Aalmoezeniers van Antwerpen, omtrent eene Leproze. (1727-1731). *Bijdragen tot de geschiedenis*, januari-februari, 1929, 17 pp. 32. Un procès entre la Supérieure de Terzieken et les doyens de la confrérie de Saint-Lazare à Rumpst. *Janus*, 1929, t. 33, 13 pp. 33. De leprozerie van Dambrugge. *Antwerpsch Archievenblad*, tweede reeks, vierde jaargang, tweede aflevering, April 1929, 28 pp. 34. Een onderzoek over de Lepra op het einde der XVIIIe eeuw te Antwerpen. *Vlaamsch Geneeskundig Tijdschrift*, nr. 18, 1929, 7 pp. 35. Quelques ambulants à Anvers, à la fin du XVIe siècle (*VIe Congrès intern. d'Histoire de la Médecine*, 1927). Anvers, 1929, 11 pp.

Cette liste n'est pas complète, car l'auteur infatigable a fait paraître depuis un très long mémoire intitulé : « Documents pour servir à l'étude des maladies pestilentielles dans le marquisat d'Anvers jusqu'à la chute de l'ancien régime (2 vols., 948 p.) dans les *Publications de la commission royale d'histoire de Belgique* (Bruxelles, 1931-32) et au moins trois autres mémoires plus petits qui seront enrégistrés dans notre Bibliographie critique.

Il est à peine besoin d'insister sur l'importance fondamentale des dépouillements d'archives auxquels se livre notre savant confrère avec tant de zèle et de succès et nous lui souhaitons — pour lui même et aussi pour nos études — de pouvoir les poursuivre pendant de longues années.

GEORGE SARTON.

Sir George Newman.—*The Rise of Preventive Medicine.* Oxford University Press. XII+270 pages. London. HUMPHREY MILFORD, 1932.

The material of this book was presented as the first series of Heath Clark lectures at the University of London. In the preface Sir GEORGE NEWMAN says that he is offering 'a general and introductory bird's-eye view of the subject of the origins of Preventive Medicine.' He defines the subject as that branch of Medicine 'which is concerned with the preventive aspects as distinct from the curative function.' But his point of view is so broad that he is able to show the relation of the significant advances in all fields of medical science to the problems of prevention of disease. The result is an excellent study of the theories of medicine and their working out in practice, as they affected the health of the whole population. This is the ideal approach to such a problem and Sir GEORGE NEWMAN has dealt with it ably, in a delightful style.

In the first chapter "Folk-lore, Magic, Custom, Religion," he considers the origin of certain hygienic customs in primitive society and particularly emphasizes the importance of general cultural history in the development of medical thought. He quotes Professor SUDHOFF on this: Everything in the collective life of humanity, which has from the beginning affected the health of the individual or the race for good or evil, must be considered and examined with regard to external and internal conditions of life, to commission and omission, to work and thought, to customs, laws, and religion." This attitude dominates the work and gives it its distinctive importance.

The second chapter "Egypt and the Mosaic Law," analyses the medical thought of these ancient civilizations, and the factors that entered into their laws of hygiene.

"Greek Medicine and the Greek Spirit" gives one of the best examples of the relation of theory to practice. It deals in some detail with the writings of HIPPOCRATES concerning the prevention of disease, as "Airs, Waters, and Places" and "Epidemics" and then tells of the contributions of the Greeks and Romans in sanitation, watersupply, sewage disposal and personal hygiene, all the result of social consciousness, achieved through education.

The transmission of Greek Medicine to England is dealt with in the fourth chapter, and in the fifth chapter, "The Middle Ages and the Black Death," are shown the social effects of the great epidemics and the means used to control them—sanitation, supervision of the infectious sick, and finally quarantine. This is an excellent, brief account of the subject.

In the sixth chapter is shown the importance of the discoveries in

Anatomy and Physiology in relation to Preventive Medicine, thus summarized : " The chief business of Conservative or Preventive Medicine is to apprehend the true nature of Man and his environment, to learn how to strengthen and use the constant internal environment (physical and mental) and control the variabilities of the external environment, and thus establish and maintain harmony between them." This was the basis of the succeeding clinical studies of disease, (Chap. VII), the final solution being achieved only with our modern discoveries in pathology and bacteriology, (Chap. VIII). As can be seen the author brings all fields of medical learning into the domain of Preventive Medicine, but always with the idea of the significance of these to this problem. In Chapter IX he shows how these discoveries were applied, and in the last chapter tells what the community, through its political and economic organization, is doing to realize the promise offered by the science of Medicine. While naturally the examples are largely of the developments in Great Britain, the same trends are in operation throughout the civilized world. The public as well as the medical man have parts to play. " Wise governance cannot as a rule exceed the assent and consent of the governed." A work of this type should help greatly in the education of both of the participants.

There are only two minor defects to be noted. The synopses at the beginning of the chapters do not always have the same arrangement as in the text, which is sometimes confusing, and the bibliographies are not well arranged.

(*San Francisco*). SANFORD V. LARKEY.

Angelo Celli.—*The history of Malaria in the Roman Campagna from ancient times* by the late ANGELO CELLI, edited and enlarged by ANNA CELLI-FRAENTZEL, with a preface by Sir ALDO CASTELLANI. (London : JOHN BALE, Sons & DANIELSSON). VIII+226 pp., 1 map. 1933, 10/6.

This study by an eminent investigator of malaria, traces over twenty-five centuries the history of malaria in the Roman Campagna describing its rise and fall in the Pre-Roman, Imperial, Medieval, Renaissance, and Modern times (1). The widespread use of cuniculi for control of drainage in districts now malarial which prevailed in the Etruscan period is not to be construed as anti-malarial in purpose, since malaria would have been suddenly destructive to such a civilization. These extensive subterranean works seem rather to be concerned with irrigation

(1) For the original Italian edition, 1925, see *Isis*, 9, 211; for the German translation, 1929, see *Isis*, 14, 513.

and to have served agriculture rather than sanitation. There is no evidence that in pre-Roman days malaria interfered with civilization, traffic or cultivation in Latium where it has since been prevalent.

In the early days of Rome the Campagna was intensively cultivated by free peasants, but from the time of the Republic malaria began to rage in Italy. The cult of the Fever Goddess was an old one and had a temple on the Palatine Hill. By the 4th Century B.C. in Southern Italy and in the Campagna there was a decline in the peasant class as cultivation gave way to pasturage as a result of the ravages of malaria. After the second Punic War it increased in violence. In the second century B.C. CATO insisted that the Campagna be settled and cultivated, but recognized the unhealthy climate in summer and was acquainted with enlargement of liver and spleen characteristic of malaria. But agrarian reforms made no headway against malaria and extensive pasture lands continued to replace the homes of agricultivators.

During the Empire malaria was widespread in Rome and the Campagna as an endemic disease. Extensive aqueducts and drainage systems were constructed and widely extended, thus improving sanitary conditions. By the 4th and 5th Centuries A.D., the Campagna and the coastal resorts seem to have been largely freed from the prevalence of the dread disease, although the classical and medical literature of the times reveals the Roman familiarity with its occurrence and symptoms.

In the 6th and 7th Centuries malaria again took possession of the Campagna and churches to the Madonna of the Fever arose. The decadence of this period was due less to the Lombards than to the increase in the frequency and gravity of malaria which filled the citizens of Rome with panic and ravaged the hordes of Huns and Vandals. By the 9th Century the country encircling Rome was again released from its grip, though the malignancy of Roman fever continued to be known to the pilgrims.

In the later Middle Ages malaria returned with renewed virulance and emperors and popes alike fell victims to the notoriously unhealthy "Rome Air." The dark ages were darkened by the ceaseless ravages of this disease which steadily defeated every effort at sanitary and agricultural amelioration of the city and its surroundings and shifted the center of civilization from Christian to Islamic control.

The ultimate solution, still in the process of successful accomplishment, had its beginnings in the suggestion of VARRO (116-27 B.C.) that malaria was caused by invisible germs in the human blood. The Jesuit ATHANASIUS KIRCHER (1601-1680) after his survey of the Pontine marshes concluded that marsh fever was the underlying cause of the century-old process which had repeatedly reduced these fertile lands to uninhabited

deserts. He commended VARRO's microbial theory of its origin. In the later part of the 17th Century VENEGAS brought cinchona to Italy and a new era of control appeared on the very eve of a new pandemic of malaria. LANCISI (1711) advanced the theory that "Mosquitoes inoculated their own bad humors into our blood" and proposed to examine the blood of patients with the microscope. But he was not implemented properly and the parasitological theory of the origin of disease was still-born. It had to wait two centuries for the work of PASTEUR, MANSON, THEOBALD SMITH, ROSS, and GRASSI for its birth, survival and fruition. The book is documented with nearly forty pages of bibliography. Though of necessity incomplete and fragmentary it is erudite and a most valuable contribution to the history of epidemiology.

C. A. KOFOID.

Fortieth Critical Bibliography

of the

History and Philosophy of Science and of the History of Civilization

(To January 1934,—with special reference to Antiquity in general, Egypt, and Mesopotamia)

This fortieth Bibliography contains about 650 items of which 130 deal with Antiquity in general, Egypt, and Mesopotamia. They have been kindly contributed by the eleven following scholars belonging to four different countries :

C. W. ADAMS (Hertford, England)
H. BEVENOT (Jerusalem)
L. GUINET (Brussels)
C. A. KOFOID (Berkeley, Cal.)
E. KREMERS (Madison, Wisc.)
S. V. LARKEY (San Francisco)
J. PELSENEER (Brussels)
A. POGO (Cambridge, Mass.)
G. SARTON (Cambridge, Mass.)
H. R. VIETS (Boston, Mass.)
M. C. WELBORN (Cambridge, Mass.)

The Bibliography includes as usual a series of addenda and errata to SARTON's *Introduction to the History of Science*, vols. 1 and 2 (Baltimore and London, 1927 and 1931). Its purpose and methods have been explained in the preface to the thirty-eighth Critical Bibliography (*Isis* 20, 506-8).

I entreat the authors of relevant books and papers to send me copies of them *as promptly as possible* in order that their studies may be registered in this bibliography and eventually reviewed and discussed. By so doing they will not simply help me and every other historian of science but they will help themselves in the best manner for they will obtain for their work the most valuable publicity and its certain and final incorporation into the literature of the subject.

Harvard Library 185.
Cambridge, Mass.

GEORGE SARTON.
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PART I

FUNDAMENTAL CLASSIFICATION (CENTURIAL)

VIIIth Century B.C.

Amos (*Introduction* 1, 57). My note on Egyptian monotheism appended to the AMOS section ought to be rewritten on the basis of JAMES HENRY BREASTED's recent book: The dawn of conscience (New York, 1933; see *Isis*, 21, 305-16). G. S. ISIS

Körner, Otto. Die zoologischen Kenntnisse in den Gedichten des HESIOD. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 59-71, 1933. ISIS

Vth Century B.C.

Bier, August. Hippokratische Studien. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 2, 1-28, 1932. ISIS

" Das Wesentliche im Hippokratismus, zu dem wir unbedingt zurückkehren müssen, bildet die Physis, mit der ihr untergeordneten Konstitution, richtigen und falschen Mischung des Körpers, Attraktion und Umstimmung. Vom Physisbegriff ist wieder das wichtigste die Physis als die den gesunden Körper beherrschende und leitende und die die Krankheiten heilende Kraft. Versteht man doch unter Physis schlechthin die sogenannte ' Naturheilkraft.' Das alles habe ich schon so ausführlich veröffentlicht, dass es mir widerstrebt, es hier zu wiederholen. Dagegen ist die Physis in einer anderen, umfassenderen und weitaus am häufigsten vorkommenden Bedeutung in meinen bisherigen Veröffentlichungen nur gestreift worden. Dies will ich hier genauer ausführen."

Deichgräber, Karl. Die ärztliche Standesethik des hippokratischen Eides. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 2, 29-49, 1932. ISIS

Diller, H. Die sogenannte zweite Fassung des 19. HIPPOKRATES-briefes. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 35-44, 1933. ISIS

Nachmanson, Ernst. Zum Nachleben der Aphorismen. *Quellen und Studien zur Gesch. der Naturw. u. d. Med.* 3, H. 4, 92-107, 1933. ISIS

" In seinem Hippokratesglossar spricht EROTIANOS die Erwartung aus, dass die Hippokratische Schriftensammlung nicht bloss von den Ärzten,

sondern von allen Menschen, ὅσοιγε λογικῆς ἀντιποιοῦνται παιδείας studiert werden würde (S. 3, 4 N.). Fortgesetzte Lektüre hat mich indessen zu der Auffassung geführt, dass dies keineswegs der Fall gewesen ist. Vielmehr trifft man in der nichtmedizinischen griechischen Literatur nur sporadisch Hippokratische Zitate und Anklänge an. Soweit meine Übersicht reicht, ist nur den Aphorismen eine etwas ausgedehntere, jedoch an und für sich nicht besonders umfangreiche Aufmerksamkeit zuteil geworden."

Sarton, George. Hippocratic oath in Arabic. (Query, no. 24). *Isis* 20, 262, 1933. ISIS

Temkin, Owsei. The doctrine of epilepsy in the Hippocratic writings. *Bulletin of the Institute of the History of Medicine* 1, 277-322, 1933. ISIS

Wellmann, Max. Das Hygienon des HIPPOKRATES. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 4, H. 1, 1-5, 1933. ISIS

Wellmann, Max. Die pseudohippokratische Schrift *Περὶ ἑβδομάδων*. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 4, H. 1, 6-10, 1933. ISIS

" Von allen Schriften des Corpus Hippokraticum hat keine in der letzten Zeit mehr das Interesse der wissenschaftlichen Welt erregt als das leider sehr schlecht überlieferte Buch 'Über die Siebenzahl,' seitdem W. H. ROSCHER mit der Hypothese an die Öffentlichkeit trat, dass dies Werk als das älteste Bruchstück ionischer Naturphilosophie zu gelten habe. Leider haben sich seine Argumente nicht als stichhaltig erwiesen. Die Kritik, die H. DIELS, LORTZING, BOLL und ILBERG an seiner Beweisführung geübt haben, haben der schönen Hypothese den Garaus gemacht."

IVth Century B.C. (second half)

Ogden, C. K. ; Richards, I. A. The meaning of meaning. 3rd edition. 364 p. London, KEGAN PAUL, 1930. ISIS

Reviewed by A. K. COOMARASWAMY, *Journal of the American Oriental Society* 53, 298-303, 1933.

Richards, I. A. MENCIUS on the mind. 175 p. London, KEGAN PAUL, 1932. ISIS

Reviewed by A. K. COOMARASWAMY, *Journal of the American Oriental Society* 53, 298-303, 1933.

Robin, Léon. Projet d'article : ARISTOTE, la vie, l'œuvre et la doctrine. *Revue de synthèse* 4, 65-92, 1932. ISIS

Sudhoff, Karl. Zur operativen Ileusbehandlung des PRAXAGORAS.

Quellen und Studien zur Gesch. der Naturw. u. d. Med., 3, H. 4, 151-54, 1933. ISIS

IIIrd Century B.C. (whole and first half)

Asin Palacios, Miguel. Una descripción nueva del Faro de Alejandría. *Al-Andalus* 1, 241-92, 1933. ISIS

Very elaborate study on the famous Alexandrian lighthouse (*Introduction* 1, 161), containing all the known descriptions of it, plus a new one by YŪSUF IBN AL SHAIKH of Malaga (1132-1207). In appendix: texts of a series of Arabic geographers on the pharos, and summary of its dimensions. Summary of this paper by the author in *Illustrated London News* of Jan. 27, 1934, p. 134-5. G. S.

Otero, Modesto Lopez. Interpretación gráfica de la descripción de IBN AL-SAYJ. *Al-Andalus* 1, 293-300, 5 pl., 1933. ISIS

Graphical interpretation of the description of the Alexandrian lighthouse by IBN AL-SHAIKH (1132-1207). Summary by the author in the *Illustrated London News* of Jan. 27, 1934, 134-5. G. S.

IIIrd Century B.C. (second half)

Archimedes. *Περὶ ὀχουμένων.* (*Introd.* 1, 170-72; II, 830). ISIS

A. *Greek text.* In 1891, A. PAPADOPOULOS KERAMEUS catalogued, in the Constantinople Metochion of the Holy sepulchre, a palimpsest which revealed a Xth century mathematical ms. below a XIIIth or XIVth century *euchologion;* the codex came from the *laura* of h. SABBA near Jerusalem; A. P. K. gave a description of this ms. 355 in his *Hierosolymitike bibliotheke*, IV, 329-31, St. Petersburg 1899. In 1906, HEIBERG—whose attention to this palimpsest was called by HERMANN SCHOENE—discovered, in the Xth century ms., in addition to fragments of already available Archimedean treatises, a considerable part of the *Ephodikon*, the beginning of the *Stomachion*, and the almost complete text of the *Ochoumena*. The Greek text of the *Ochoumena*, and HEIBERG's Latin translation of it, *De corporibus fluitantibus*, were published in the 2nd ed. of vol. II (1913) of ARCHIMEDES' works.

B. *Moerbeke's Latin translation.* In 1881, VALENTIN ROSE discovered, in the codex Vatic. Ottobon. lat. 1850, the dated autograph translation, *De insidentibus in humido*—completed, December 10, 1269—along with several other MOERBEKE versions of Archimedean and other treatises. ROSE announced his discovery in 1884, in the *DLZ*, 5, 210-13, and solved the mystery surrounding the TARTAGLIA-COMMANDINO Latin version of the *Ochoumena*. MOERBEKE's autograph translation was consulted by LEONARDO DA VINCI, in the beginning of the cinquecento (cf. the *Codice Atlantico* or WILH. SCHMIDT's paper in *Bibl. math.*, 3, 176-79, 1902). TARTAGLIA's edition of *De insidentibus aquae* (book I, Venice 1543; book II, published posthumously by TROIANUS CURTIUS, together with a reprint of book I, Venice 1565) uses—TARTAGLIA's misleading claims notwithstanding—the

MOERBEKE translation—apparently, the ms. copy now in Madrid. COMMANDINO's edition of *De iis quae vehuntur in aqua* (Bologna 1565) uses—also without acknowledgment—either MOERBEKE's autograph translation or a good copy of the Ottobonianus. Thus, TARTAGLIA-COMMANDINO remained, for more than three centuries, the fountain-heads of our knowledge of Archimedean hydrostatics; if it were not for their editorial activities, the Latin source could have remained unproductive from 1269 until 1881—even if we take into consideration the few Archimedean passages in the *Codice Atlantico*. MOERBEKE's literal translation did not lose its importance after the discovery of the Constantinople ms. because it contains long passages missing in the palimpsest.

C. *Other translation.* The first attempt at understanding some obscure passages of MOERBEKE's literal version by way of a Greek re-translation was made in the XVIth century (fragments edited by ANGELO MAI, *Classici auctores*, I, 426-30, Rome 1828; MAI's sources identified by HEIBERG, in 1881, as cod. Vat. gr. 1316 and 1347; cf. *Mélanges Graux*, p. 690, Paris 1884). A further attempt at a partial re-translation into "Doric" was made by DAVID RIVAULT DE FLEURANCES, in his edition of ARCHIMEDES (Paris 1615). An excellent re-translation of book I was made by HEIBERG (*Mélanges Graux*, 689-709, 1884)—a comparison with the original text discovered in 1906 is very illuminating. The first vernacular version of the *Ochoumena* was made by TARTAGLIA, in his *Ragionamenti sopra la sua travagliata inventione*, Venice 1551. For a partial Arabic translation of the *Ochoumena*, in a Xth century ms., see ZOTENBERG, *Journ. asiatique*, 13, 509-15, 1879. A. P.

Archimedes. Arenarius. Quadratura parabolae. Dimensio circuli. (*Introd.* 1, 169-72). ISIS

Archimedean incunabula seem to be extremely rare—there is, in the Bodleian, an apparently unique copy of an undated XVth cent. edition of the ψαμμίτης, in Greek, printed in England.

The first Archimedean treatises which appeared in print, in Latin,—in the version of WILLIAM OF MOERBEKE (1269)—were the *Quadratura parabolae* and the *Dimensio circuli;* they were included in the book entitled: Tetragonismus id est circuli quadratura per Campanum Archimedem Syracusanum atque Boetium mathematicae perspicacissimos adinuenta (Venice, I. B. SESSA, 1503). The editor was LUCA GAURICO; the name of the translator was not mentioned; the ms. of which the partial publication was thus begun, was Ottobonianus 1850. The *Quadratura parabolae* and the *Dimensio circuli* were reprinted, without acknowledgment, but with the misprints of the 1503 edition, in TARTAGLIA's *Opera Archimedis* (Venice, V. RUFFINELLI, 1543). A. P.

Loria, Gino. Les miroirs ardents d'ARCHIMÈDE. Query, no. 32. *Isis* 20, 441, 1934. ISIS

Ist Century B.C. (second half)

Meyerhof, Max. Die Materia medica des DIOSKURIDES bei den Arabern.

Quellen und Studien zur Gesch. der Naturw. u. d. Med. 3, H. 4, 72-84, 1933. ISIS

" Nächst den Hauptwerken des HIPPOKRATES und GALEN hat die Schrift des DIOSKURIDES über die einfachen Heilmittel, die *Materia Medica*, bei den Gelehrten des arabisch-islamischen Kulturkreises im höchsten Ansehen gestanden. Einen neuen Beweis dafür lieferte mir die vor etwa drei Jahren von H. RITTER in Istanbul wieder aufgefundene Arzneimittellehre des grossen arabischen Geographen EDRISI, in deren Einleitung der gelehrte Fürst von den früheren Verfassern arabischer Pharmakologien spricht und dann fortfährt : ' Da fasste auch ich die Quelle ins Auge, aus welcher sie geschöpft, und den Schatz, aus welchem sie entlehnt hatten : siehe, das ist das Buch des Griechen DIOSKURIDES, das er über die einfachen Heilmittel aus dem Pflanzen-, Tier- und Mineralreich verfasst hat. Da machte ich es zu meinem Koran und studierte es mit Inbrunst, bis ich seinen ganzen Wissensstoff auswendig gelernt hatte...' Wohl nichts kann mehr die Verehrung beweisen welche AL-IDRĪSĪ für diese Schrift hegte, als seine für einen Muslim fast blasphemische Vergleichung mit dem heiligen Buche des Islām. Bei vielen anderen Gelehrten, besonders in Werken oder Abschnitten über Drogen, treffen wir den Namen DIOSKURIDES auf jeder Seite an."

IInd Century (whole and first half)

Gandz, Solomon. The Mishnat ha-middot, the first Hebrew geometry of about 150 C.E., and the Geometry of MUHAMMAD IBN MUSA AL-KHOWARIZMI, the first Arabic geometry (c. 820), representing the Arabic version of the Mishnat ha-middot. A new edition of the Hebrew and Arabic texts with introduction, translation and notes. VIII+96 p., 14 fig., 4 pl. (*Quell. u. Stud. zur Gesch. d. Math.*, Abtg. A, Bd. 2). Berlin, SPRINGER, 1932. ISIS

Reviewed by WILLIAM THOMSON, *Isis* 20, 274-80, 1933.

(Ptolemy). CLAUDII PTOLEMAEI Geographiae codex Urbinas Graecus 82. Phototypice depictus consilio et opera curatorum Bibliothecae Vaticanae (Codices e Vaticanis selecti quam simillime expressi iussu PII XI P.M. Series maior, volumen XVIII. Tomi quatuor, folio maiore et quarto). Leiden, E. J. BRILL, 1932 (350 copies printed costing 450 Dutch florins each). Tomus prodromus. JOSEPHI FISCHER (S.J.) de CL. PTOLEMAEI vita operibus geographia praesertim eiusque fatis. Pars prior. Commentatio (xvi+608 p.). Pars altera. Tabulae geographicae lxxxiii graecae arabicae latinae e codicibus liii selectae. (xii p., pl.). Pars prior. Textus cum appendice critica PII FRANCHI DE CAVALIERI. (40 p., facs.). Pars altera. Tabulae geographicae. Accedunt tabulae viginti septem codicis Vaticani latini 5698 tres Urbinatis graeci 83. (Elephant folio volume ; the three other parts being quarto). ISIS

Reviewed by G. SARTON, *Isis* 20, 267-70, 1933.

(Ptolemy). Geography of CLAUDIUS PTOLEMY. Translated into English and edited by EDWARD LUTHER STEVENSON. Based upon Greek and Latin manuscripts and important late fifteenth and early sixteenth century printed editions. Including reproductions of the maps from the Ebner manuscript, ca. 1460. Introduction by JOSEPH FISCHER (S.J.). XVI+167 p., 29 maps. New York, Public Library, 1932 (250 copies). ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 270-74, 1933.

IInd Century (second half)

Danby, Herbert. The Mishnah. Translated from the Hebrew with introduction and brief explanatory notes. 876 p. Oxford, Clarendon Press, 1933. ISIS

"The Mishnah, or compilation of oral laws made at the close of the second century A.D., ranks second only to the Hebrew Scriptures as a Jewish national-religious creation and possession, and for sixteen centuries has been an essential ingredient in the education of orthodox Jews, and an object of devotional study through life. In its entirety, however, it has not hitherto been accessible in English; some portions have been translated, but such fragmentary presentation fails to give a true idea of its nature. The present translation displays it for the first time in English as a systematic whole; the text used is that of the ordinary printed editions of the Mishnayoth. The notes aim at explaining allusions and removing surface difficulties, but do not attempt to provide a complete commentary to the matters dealt with in the text."

Schöne, Hermann. GALENOS' Schrift über die Siebenmonatskinder. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 120-38, 1933. ISIS

"Unter den Schriften, die HIPPOKRATES' Namen tragen, ist en Buch *Περὶ ἑπταμήνου* und ein anderes *Περὶ ὀκταμήνου* erhalten. Auch GALEN hat ein Buch *Περὶ τῶν ἑπταμήνων* und ein anderes *Περὶ τῶν ὀκταμήνων τῆς γενέσεως* verfasst. Von den letzteren beiden ist das zweite verloren und seine ehemalige Existenz nur durch Selbstzitate in griechisch und arabisch erhaltenen Texten GALENS gesichert. Was dagegen von GALENS Schrift über die Siebenmonatskinder erhalten geblieben ist, soll hier aus einer Florentinischen Handschrift in durchgeprüftem Texte vorgelegt werden." Critical editions of the text, German translation, and introduction. G. S.

Wenkebach, Ernst. Der hippokratische Arzt als das Ideal GALENS. Neue Textgestaltung seiner Schrift *"Οτι ὁ ἄριστος ἰατρὸς καὶ φιλόσοφος*. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 155-75, 1933. ISIS

Critical edition of that text with 16 p. introduction. G. S.

IIIrd Century (second half)

Pelseneer, J. PAPPUS d'Alexandrie. *Mathesis*, 328-33 (s.a.). ISIS

Étude d'ensemble à propos des travaux récents de P. VER EECKE, A. ROME G. JUNGE, W. THOMSON, etc. G. S.

Rome, A. PAPPOS d'Alexandrie. Query, no. 30. *Isis* 20, 440, 1934. ISIS

Ver Eecke, Paul. La mécanique des Grecs d'après PAPPUS d'Alexandrie. *Scientia* 54, 114-22, 1933. ISIS

IVth Century (second half)

Rome, A. THÉON d'Alexandrie. Query, no. 29. *Isis* 20, 440, 1934. ISIS

Schenk, Dankfrid. FLAVIUS VEGETIUS RENATUS. Die Quellen der Epitoma Rei Militaris. VIII+88 p. (*Klio*, Beiheft 22). Leipzig, DIETERICH, 1930. ISIS

Reviewed by ROBRET GROSSE, *DLZ* 5, 61-65, 1934.

Vth Century (second half)

Stevens, C. E. SIDONIUS APOLLINARIS and his age. 238 p., map, pl. Oxford, Clarendon Press, 1933. ISIS

" The letters of SIDONIUS offer a picture of life in fifth-century Gaul and Italy, of which the peculiar interest has long been recognized. The last product of the classical education, born into an age when men still regarded the Roman Empire and civilization as conterminous, SIDONIUS took part in the final struggles of that empire, saw its collapse in A.D. 476, and lived to become a subject of the Visigoths. He rose to be Praefectus Urbis in the Imperial administration before he returned to Gaul to become Bishop of Clermont and to defend his city against a Visigothic siege."

VIth Century (whole and first half)

Morin, Germain. S. CAESARII ARELATENSIS Episcopi regula sanctarum Virginum aliaque opuscula ad sanctimoniales directa, ad normam codicum nunc primum edidit. 52 p. Bonn, HANSTEIN, 1933. ISIS

Three plates of high paleographical interest add to the value of the final edition of this, one of the best Rules ever written for nuns. It was soon welded with and then eclipsed by the Rule of St. BENEDICT, a contemporary alike of CASSIODORUS and CAESARIUS. H. B.

VIIIth Century (second half)

Buckler, F. W. HARUNU'L-RASHID and CHARLES THE GREAT. VII+64 p. Cambridge, Mass., Mediaeval Academy of America, 1931. ISIS

" In the light of the Umayyad and 'Abbāsid feud there is nothing inherently improbable either in the negotiations or in the form they took, particularly if the suggestion to PIPPIN came either from discontented Spanish amirs or from Alexandria or from both. The fundamental condition to be borne in mind is that the approach made by PIPPIN, and later by CHARLES, to the Khalīfah placed them both in the status of petitioners, while the political framework underlying the negotiations was primarily Muslim. Hence, it follows that the whole chapter lies within the realm of Muslim rather than Christian history. In that light the grant of a ' protectorate ' or wilāyat over the Holy Places is admissible; but it is to be assumed that it was as a vassal, not as an equal of the Khalīfah, that CHARLES received it. Similarly, too, the grant of authority over the 'Abbāsid party in Spain falls into the same category. Western historians and diplomatists have been far too prone to read into Oriental and mediaeval history the usages of their own diplomatic code, and, with the exception of Sir THOMAS ROE's difficulties at the court of JAHĀNGĪR, there are few examples more striking in the relations between the East and the West than this episode, whose dramatic irony culminates in the Pope's doing homage to the accredited deputy of the Successor of the Prophet of God ! " See review by W. BJÖRKMAN (*OLZ* 36, 693-95, 1933). G. S.

Xth Century (whole and first half)

Erlanger, Baron **Rodolphe d'.** La musique arabe. T. I : AL-FĀRĀBI, ABŪ N-NAṢR MUḤAMMAD IBN MUḤAMMAD IBN TARKHĀN IBN UZLAGH. Grand traité de la musique. Kitābu-l-mūsīqī al-kabīr. Livres I et II. Traduction française. XXVIII+329 p., 125 fig. Paris, GEUTHNER, 1930. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 280-83, 1933.

Farabi. Catálogo de las ciencias. Edición y traducción Castellana por ANGEL GONZÁLEZ PALENCIA. XX+176+84 p. (Publicaciones de la Facultad de filosofía y letras, Universidad de Madrid, 2). Madrid, MAESTRE, 1932. ISIS

Reviewed by D. B. MACDONALD, *Isis* 20, 450-51, 1934.

Farmer, Henry George. The " Iṣḥā' al-'ulūm." *Journal of the Royal Asiatic Society*, 906-09, 1933. ISIS

Fyzee, Asaf A. A. QADI AN-NU'MAN. The Fatimid jurist and author. *Journal of the Royal Asiatic Society*, 1-32, 1934. ISIS

Stapleton, Henry Ernest. Three Arabic treatises on alchemy by MUḤAMMAD IBN UMAIL (10th century A.D.). Edition of the texts by M. TURĀB 'ALĪ. Excursus on the writings and date of IBN UMAIL with edition of the Latin rendering of the *Mā' al-waraqī*. By H. E. STAPLETON and M. HIDĀYAT ḤUSAIN. 231 p., 2 pl. 31 × 25 cm. (*Memoirs of the Asiatic Society of Bengal* 12, 1-213). Printed at the Baptist Mission Press; published by the Asiatic Society of Bengal, 1, Park Street, Calcutta 1933 (Rs. 9-0-0). ISIS

An elaborate review of this very important publication is being prepared by Professor J. RUSKA, to appear in *Isis* as promptly as possible. G. S.

Xth Century (second half)

Carter, Barbara Barclay. ROSWITHA of Gandersheim. *Dublin Review*, 284-95, 1933. ISIS

Esquisse littéraire des drames de HROSVITA. H. B.

Ismā'īl ibn al-Qāsim al-Qālī. A facsimile of the manuscript of Al-kitāb al-bāri' fi'l-lughah. Edited with an introduction by A. S. FULTON. 15+148 p. London, British Museum, 1933 (10/6). ISIS

This Ms. ,Or. 9811 ,was written on vellum by an Andalusian scribe probably in the eleventh century. The text is incomplete, as is that of the only other Ms. Paris, De Slane 4235. The British Museum fragment is 3 1/2 times larger than the Paris one, and only a small portion is common to both. The author was born in Manāzjird, Armenia, N. of lake Van in 901, studied in Baghdād and Mūṣul and finally emigrated to Cordova where he was very warmly received in May 942. Ten works are ascribed to him of which seven are entirely lost. Al-kitāb al-bāri' fi'l-lughah (The preeminent book on lexicography) is a dictionary of the Arabic language, which exceeded AL-KHALĪL's Kitāb al-'ain by over 400 leaves. It was begun in 950 and finished in 966; the author died before the final copy was made up. AL-QĀLĪ's arrangement, even as AL-KHALĪL's, was a strange phonetic one, making the use of his dictionary very difficult. G. S.

Nadīm, Ibn al-. Al-fihrist (Arabic edition of the Fihrist, with an Arabic introduction by one of the professors of the Egyptian University). 6+528+8 p. Al-muktabah al-tajāriyah al-kubrā, SHĀRI' MUḤAMMAD 'ALĪ, Cairo, 1348 (1929-30). ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 283-85, 1933.

Ritter, Hellmut. Pseudo-Magrīṭī, Das Ziel des Weisen. VI+416 p. (Studien d. Bibl. Warburg, 12). Leipzig, TEUBNER, 1933. ISIS

Apropos of the Arabic treatise Ghāyat al-ḥakīm, better known to mediae-

valists under the Latin title Picatrix (*Introduction* 1, 668; *Isis* 6, 147). The Ghāyat al-ḥakīm was composed in 959-60 probably, not by AL-MAJRĪṬĪ, (d. 1007) but by another astrologer, who, according to his own statement, had written the Rutbat al-ḥakīm five years earlier. See review by MAX MEYERHOF, *DLZ* 4, 2370-72, 1933.

Unwalla, J. M. The translation of an extract from Mafātīh al-'ulūm of AL-KHWĀRAZMĪ. 35 p. *Journal of the K. R. Cama Oriental Institute*, no. 11, Bombay, 1928. ISIS

This extract, edited in Arabic and translated into English, contains an interesting list of Persian, Turkish and Indian words which occur in Arabic historical writings. Indices. See my *Introd.* (vol. 1, 659). G. S.

XIth Century (whole and first half)

al-Bīrūnī. Das vorwort zur Drogenkunde des BĪRŪNĪ. Eingeleitet, übersetzt und erläutert von MAX MEYERHOF. 52+18 p. (*Quell. u. Stud. zur Gesch. d. Naturw. u. d. Med.* 3, H. 3). Berlin, SPRINGER, 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 451-54, 1934.

XIIth Century (second half)

Farmer, Henry George. MAIMONIDES on listening to music. *Journal of the Royal Asiatic Society*, 867-84, 1933. ISIS

al-Ghāfiqī, Aḥmad ibn Muḥammad. The abridged version of " The book of simple drugs " of AḤMAD IBN MUḤAMMAD AL-GHĀFIQĪ by GREGORIUS ABU L-FARAG (BARHEBRAEUS). Edited from the only two known manuscripts with an English translation, commentary and indices by M. MEYERHOF and G. P. SOBHY. 236 p. (The Egyptian University), The Faculty of Medicine, publication, no. 4). Cairo, 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 454-57, 1934.

Hung Mai. Jung-chai sui-pi wu chi-tsung ho yin-tê. (Combined indices to the five collections of miscellaneous notes of HUNG MAI, 1123-1202. 26+123 p. (Harvard-Yenching Institute Sinological index series, 13). Peiping, 1933. ISIS

For HUNG MAI, see *Introduction* 2, 262. " The miscellaneous notes, 1219 in number, of HUNG MAI cover a wide range of critical comments on Chinese history and literature and contain valuable information on the institutions of the Sung dynasty." G. S.

Josef ben Meir ibn Sabara. Llibre d'ensenyaments delectables. (Biblioteca Hebraico-Catalana, 2). Barcelona, 1931. ISIS

Reviewed by J. MILLÁS, *Al-Andalus* 1, 491, 1933. Spanish translation with notes of the Sefer sha'shu'im (see my *Introduction* 2, 381). G. S.

Yūsuf ibn al-Shaihk of Malaga (1132-1207). See notes on M. ASIN PALACIOS and M. L. OTERO in section on III(1)B.C. G. S. ISIS

XIIIth Century (whole and first half)

Bartholomeus Anglicus. De proprietatibus rerum (Book seventh—on medicine). Translated and annotated with an introductory essay by JAMES J. WALSH. *Medical life* 40, 453-96, 499-544, facs., 1933. ISIS

García Gómez, Emilio. AL-SHAQUNDĪ. Elogio del Islam español. 123 p. (Publicaciones de las escuelas de estudios árabes de Madrid y Granada, B, 2). Madrid, ESTANISLAO MAESTRE, 1934 (4 pesetas). ISIS

It is fitting that the new collection of the Hispano-Arabic school should include an annotated translation of this famous Arabic text written to the glory of Spain (as opposed to Barbary !) by ABŪ-L-WALĪD ISMĀ'ĪL BIN MUḤAMMAD AL-SHAQUNDĪ (Shaqunda, i.e., Secunda, was the name of a little town opposite Cordova on the left bank of the Guadalquivir). AL-SHAQUNDĪ died in 1231-32 (see *Encycl. of Islam*, 4, 291) and was the leading man of letters of Andalusia in his time. I did not speak of him in my *Introduction* because he had no interest in science. The references to science in the present text are exceedingly meager (p. 55). The translation has been prepared with loving care and is well annotated and indexed. G. S.

XIIIth Century (second half)

(Albert the Great). Acta PII PP XI. Litterae decretales sancti ALBERTI MAGNI O.P. confessoris pontificis cultus universae praecipitur ecclesiae, addito doctoris titulo. Pius episcopus servus servorum Dei ad perpetuam rei memoriam. *Acta apostolicae sedis* 24, 5-24, Rome, Jan. 1932. ISIS

(Bacon, Roger, 1214-92). The writings of ROGER BACON. *Nature* 132, 809-10, 1933. ISIS

Arnold of Villanova (*Introduction* 2, 893). Although no date has yet been determined for the composition of the *Speculum medicinae*, one of ARNOLD's longest medical works, it is evident from a letter

written by JAMES II OF ARAGON to ARNOLD, that it was written before 1308. In this letter, dated Valencia, July 1, 1308, the king says, "Ceterum recolimus nuper vobis precando scripsisse per litteras quas vobis dilectus consiliarius et magister racionalis curie nostre PETRUS BOYL debuit presentare ut ad nos novellum opus per vos conditum, *medicine speculum* nuncupatum, pro conservatione salutis nostre mittere deberetis, sane quare ignoratur a nobis utrum dicte littere ad vos pervenerint, providenciam vestram iterato precamur quatenus opus predictum seu *speculum medicine* ad nos pro conservacione nostre salutis, quam ut tenemus certissime tenere cupitis, per fidum vestrum nuncium sublato more dispendio transmitatis, scituri nos opus ipsum nemine communicaturos nisi previo consensu vestro magistro MARTINO DE CALIGA RUBEA nostro phisico id pandamus, qui de salute et sanitate corporis nostri sollicitam curam gerit." This letter is found in the *Documents per l'historia de la cultura catalana mig-eval*, published by A. RUBIÓ Y LLUCH, I, 45, Barcelona, 1908. M. C. W. ISIS

Guinagh, Kevin. An unpublished manuscript of ROGERIUS ANGLICUS. *Speculum* 9, 91-94, 1 facs., 1934. ISIS

Högberg, Paul. Une édition rarissime du Roman de la rose, dans la Bibliothèque de l'Université royale d'Uppsala. Uppsala Universitets Biblioteks Minnesskrift 1621-1921, 268-81, Uppsala, ALMQUIST & WIKSELL, 1921. ISIS

Laurent, P. GEORGES PACHYMERES. Query no. 28, *Isis* 20, 440, 1934. ISIS

Meyerhof, Max. IBN AN-NAFĪS und seine Theorie des Lungenkreislaufs. *Quellen und Studien zur Geschichte der Naturw. u. d. Med.*, 4, H. 1, p. 37-88+22 p., 1933. ISIS

We need not insist upon the great importance of this paper as the author has kindly promised to prepare an English paper on the subject for *Isis*. It will suffice to say that my preliminary statement in my *Introduction* (vol. 2, 1100) is entirely substantiated and the Syrian doctor IBN AN-NAFĪS thus becomes one of the greatest personalities of the Middle Ages. If I had had no doubts about the subject (it was almost too good to be true) I would have spoken of it not only as I did in the text of my *Introduction* but in the prolegomena, which are now in this particular respect very insufficient. So much the better: it shows that our knowledge is gradually increasing.

The Arabic part of MEYERHOF's memoir (22 p.) contains IBN AN-NAFĪS' biography extracted from the book *Al-wāfī bi'l-wafayāt* of AL-ṢAFADĪ (1296-1363), then extracts from IBN AN-NAFĪS' *Sharḥ tashrīḥ* IBN SĪNĀ. These

extracts are edited on the basis of two MSS., the Berlin one already known and another in the author's possession.

IBN AN-NAFIS died in Cairo (not Damascus) in 1288, having by that time understood the circulation of the blood as well as MICHAEL SERVETUS (in 1553) almost three centuries before the latter. G. S.

Mitchell, J. B. The MATTHEW PARIS maps. *Geographical Journal* 81, 27-34, 1933. ISIS

A consideration of the four versions of the map of Britain. C. W. A.

Scalinci, Noè. A proposito di ALESSANDRO DELLA SPINA et di storia della invenzione degli occhiali. *Rivista di storia delle scienze mediche* 24, 139-43, 1933. ISIS

Schwertner, Thomas M. (O.P.). St. ALBERT THE GREAT. XXXII+ 375 p., 10 pl. New York, BRUCE, 1932 ($3.00). ISIS

This is an appraisal of the life and work of ALBERTUS MAGNUS, primarily from the religious and philosophical point of view. Three chapters are devoted to his scientific work and its place in the development of mediaeval thought. The chapter entitled " The pioneer scientist " emphasizes the value of the priesthood in a war-ridden world of soldiers and princelings in interpreting nature to the people in daily contact with the facts and forces of the natural world. ALBERT's writings exhibit his wide interest in the natural and physical sciences, meteorology, chemistry, physics, medical lore, and the plant and animal life of his environment. The claim is made that ULRICH OF STRASBURG depended upon ALBERT for his mathematics and art of clock building, that DIETRICH OF FREIBERG used his aid in formulating the " Theory of the rainbow " and that VINCENT OF BEAUVAIS drew heavily upon him for the material in his " Speculum naturale." He came to be known to his many followers as " doctor expertus " and they acquired the name of " experimentatores." This adumbration of the future method of the sciences is used to justify the title of " Pioneer scientist " for ALBERT. The title " All-seeing naturalist " is based on his " De vegetabilibus " and " De animalibus ", both of which have been appraised in Dr. SARTON's *Introduction* (vol. 2, 934-44) and on his chemical knowledge, appraised by Professor STILLMAN. In the chapter on " Experimentalist, not magician " note is made that many popular works on magic ascribed to ALBERT are spurious compilations which misrepresent the intelligence of this pioneer experimenter. The popularizers of ALBERT's day beheld in all his efforts to advance medicine and chemistry " nothing but black magic with its more or less frank trickery, mountebankery, and mystification." His very scientific work was thus transformed by the charlatans of his day into a malodorous conglomeration of " secrets " widely associated with his name, but for whose debased use he was not responsible.

The book has an extensive list of primary and secondary sources and an interesting series of portraits from ecclesiastical sources. There are some unfortunate oversights, sometimes repeated, in proof reading, such as KONRAD VON MEYERBERG (for MEGENBERG). C. A. K.

Solalinde, A. G. What the research group in Spanish medieval studies is doing. Paper read before the Language and Literature Club of the University of Wisconsin on Jan. 19, 1934. 6 p. typewritten.

ISIS

Ambitious program of investigations concerning the published and unpublished works of King ALFONSO X of Castile. G. S.

Steele, Robert. ROGER BACON as professor. A students' notes. *Isis* 20, 53-71, 1933. ISIS

" MS. 16089 of the Bibliothèque Nationale at Paris consists of a number of miscellaneous tracts. One of them contains what are most probably the lecture notes of a student at the University of Paris who attended the lectures of ROGER BACON on mathematics." The first lecture here printed " is headed *Reprobaciones Rogeri Baconis* from its explicit. The title may be taken as equal to ' criticisms ' or ' re-statements.' The subject matter is the accuracy of EUCLID's definitions. BACON valued the propositions of EUCLID as statements of fact, not as exercises in correct reasoning, but he insists on clear thinking in the definition of his terms and anticipates some modern criticisms of them." " The second lecture on the uses of mathematics is important as showing that in the *Opus Majus* BACON incorporated a quantity of previously written matter."

Thorndike, Lynn. RUFINUS. *Isis* 20, 445, 1934. ISIS

Correction to THORNDIKE's RUFINUS paper (*Isis* 18, 63-76, 1932; 19, 390, 1933). G. S.

William of Moerbeke (*Introduction* 2, 829-31). Apropos of his translation of ARCHIMEDES' *Ochoumena* the Greek text of which is *not* lost, see note by A. POGO in the section devoted to III(2) B.C. G. S.

ISIS

XIVth Century (whole and first half)

Asín Palacios, Miguel. Sobre las fuentes islámicas de la " Divina comedia." *Al-Andalus* 1, 451-53, 1933. ISIS

Chang, T. T. CHIA MING's Elements of dietetics. A summary of the first volume, with an introduction. *Isis* 20, 324-34, 1934. ISIS

CHIA MING (c. 1268-c. 1374) wrote Elements of dietetics (Yin shih hsü chih) divided into eight books : 1. Water and fire; 2. cereals; 3. vegetables; 4. fruits; 5. condiments and dainties; 6. fish; 7. fowl; and 8. animals. This paper is a summary of the first book. G. S.

Dante. Die Handschriften des Briefes DANTES an CAN GRANDE DELLA SCALA mit den bisher unbekannten, zum ersten Male veröffentlichten Handschriften der Biblioteca Nazionale Centrale in Florenz : Maglia-

bechiano Cl. VII, 1028 und Filza Rinuccini 19 in Faksimile-Druck hg. u. eingeleitet von FRIEDRICH SCHNEIDER. XVI+83 p. Zwickau i. Sa., ULLMANN, 1933. ISIS

Reviewed by ULRICH LEO, *DLZ* 4, 2409-13, 1933.

Lindner, Benedikt. Die Erkenntnislehre des THOMAS VON STRASSBURG. Nach den Quellen dargestellt. X+141 p. (Beiträge z. Gesch. d. Philos. u. Theol. d. Mittelalt. Texte u. Untersuchgn. 27) Münster i.W., ASCHENDORFF, 1930. ISIS

Reviewed by JOSEF KOCH, *DLZ* 4, 1975-77, 1933.

Pelham, R. A. The Gough map. *Geographical Journal* 81, 34-39, 1933. ISIS

"A map of Britain, bequeathed to the Bodleian by RICHARD GOUGH in 1799, topographically of far greater value than any other surviving map of Britain of the period. Very likely constructed during the second quarter of the fourteenth century." C. W. A.

Petrarca, Francesco. Le familiari. Edizione critica per cura di VITTORIO ROSSI. Vol. I: Introduzione e libre I-IV. CLXXII+204 p., port., 6 pl. (Edizione nazionale delle opere di FRANCESCO PETRARCA, 10). Florence, SANSONI, 1933. ISIS

Reviewed by PAUL PIUR, *DLZ* 4, 2227-30, 1933.

Quint, Josef. Die Überlieferung der deutschen Predigten Meister ECKEHARTS textkritisch untersucht. XLIV+957 p. Bonn, RÖHRSCHEID, 1932. ISIS

Reviewed by REINHOLD SEEBERG, *DLZ* 4, 2259-65, 1933.

Rees, William. Historical map of South Wales and the border counties in the fourteenth century. In four sheets. With a handbook. Southampton, Ordnance Survey Office. ISIS

Elaborate review by H. J. RANDALL, *Antiquity* 7, 329-36, 1933.

(Richard de Bury). Philobiblon of RICHARD DE BURY. XIV+75 p. Berkeley, Book Arts Club of the University of California, 1933 (not seen). IISS

aṣ-Ṣafadī, Salāḥuddīn Khalīl Ibn Aibak (1296-1383). Das biographische Lexikon. Teil I, hrsg. von HELLMUT RITTER. 385 p. (Bibliotheca Islamica, 6a). Istanbul, Staatsdruckerei, 1931 (arabisch). ISIS

Reviewed by C. BROCKELMANN, *OLZ* 36, 691-93, 1933.

XIVth Century (second half)

Andel, M. A. van. GEERT GROOTE en de kwakzalver. *Bijdragen tot de geschiedenis der geneeskunde* 13, 212, 1933. ISIS

Epstein, Isidore. The Responsa of Rabbi *Simon b. Ẓemaḥ Duran* (1361-1444) as a source of the history of the Jews in North Africa. X+108 p. (Jews' College publications, no. 13). London, Oxford University Press, 1930. ISIS

Reviewed by I. ELBOGEN, *OLZ* 37, 32, 1934; in *Jewish Quarterly Review* 24, 251-53, 1934.

Guerra, G. del. Per la storia degli amuleti : una preghiera contra la peste del 1400. *Rivista di storia delle scienze mediche e naturali* 24, 49-53, 1 facs., 1933. ISIS

Krauss, Russell ; Braddy, Haldeen ; Kase, C. Robert. Three CHAUCER studies : I. Chaucerian problems : especially the Petherton forestership and the question of THOMAS CHAUCER ; II. The Parlement of Foules in its relation to contemporary events ; III. Observations on the shifting positions of groups G and DE in the manuscripts of the Canterbury Tales. VII+182+101+89 p. New York, Oxford University Press, 1932. ISIS

Reviewed by B. J. WHITING, *Speculum* 8, 531-38, 1933.

Laurent, Henri. La loi de GRESHAM au Moyen Age : essai sur la circulation monétaire entre la Flandre et le Brabant à la fin du XIV^e^ siècle. IX+208 p. (Travaux de la Faculté de philosophie et lettres de l'Université de Bruxelles, 5). Brussels, l'Université de Bruxelles, 1933. ISIS

Reviewed by ABBOTT PAYSON USHER, *American Historical Review* 39, 156, 1933.

Laurent, Henri. Le problème des traductions françaises du traité des monnaies d'ORESME dans les Pays-Bas bourguignons (fin du XIV^e^ — début du XV^e^ siècle). 24 p. (Faits et doctrines monétaires au moyen âge). *Revue d'Histoire économique et sociale*, 21, 1933. ISIS

Macler, Frédéric. L'Islam dans la littérature arménienne d'après la publication récente du « livre des questions » de TATHEWATSI. *Revue des études islamiques*, année 1932, cahier 4, 493-522 (reçu en oct. 1933). ISIS

A propos d'un ouvrage de l'évêque arménien BABGÊN KULÉSÉRIAN dont

la première partie a été publiée par les Mékhitaristes de Vienne en 1930. Il contient le chapitre Contre les Tadjik du *Livre des questions* de GRÉGOIRE DE TATHEW qui fut éliminé de l'édition de 1730. Deux parties ultérieures contiendront un recueil critique des écrits arméniens sur l'Islam avant et après le TATHÉWATSI (celui-ci mourut vers 1410 et son *Livre des questions* fut terminé en 1397), et une étude sur l'Islam. G. S.

Manly, John Matthews. MARY CHAUCER's first husband. *Speculum* 9, 86-88, 1934. ISIS

Schmutzer, Richard. Die Schrift des Meisters ALBRECHT über Pferdekrankheiten. Nach der Handschrift Nr. 82 der Fürstlich Fürstenbergischen Hofbibliothek zu Donaueschingen. *Quellen und Studien zur Gesch. der Naturw. u. d. Med.* 4, H. 1, 11-36, 1933. ISIS

" Den Namen des Meisters ALBRECHT, ALEBRAND, ALBRANT tragen, vom späten Mittelalter angefangen, eine Reihe von Handschriften, deren eine RIECK veröffentlicht hat mit dem Bemerken, dass die älteste Fassung der Schrift wohl die nachstehend zum Abdruck gelangende sei. Hiernach allein schon kommt ihr also besondere Bedeutung zu. Hs. 82 stammt aus dem 14. Jahrhundert (wohl 2. Hälfte). " Critical edition of this German veterinary poem (273 lines) with introduction, list of ailments, notes, index. G. S.

Stein, I. H. An unpublished fragment of WYCLIF's Confessio. *Speculum* 8, 503-10, 1933. ISIS

XVth Century (whole and first half)

Birkenmajer, Alexander. ANTONIO CERMISONE über die Pest. Query no. 27. *Isis* 20, 440, 1934. ISIS

Feis, Oswald. Bericht aus dem Jahre 1411 über eine Hebamme, die angeblich 7 Kaiserschnitte mit gutem Erfolg für Mutter und Kind ausgeführt hat. *Archiv für Geschichte der Medizin* 26, 340-43, 1933. ISIS

Nicolaus de Cusa. Opera omnia. II. Apologia doctae ignorantiae. Edidit RAYMUNDUS KLIBANSKY. XII+49 p. (Iussu et auctoritate Academiae Litterarum Heidelbergensis ad codicum fidem edita). Leipzig, MEINER, 1932. ISIS

Reviewed by S. KURLAND, *Isis* 20, 457-64, 1934.

Thorndike, Lynn. GIOVANNI DA FONTANA again. *Isis* 20, 335-36, 1934. ISIS

XVth Century (second half)

Casarini, A. Gli ospedali da campo della Regina ISABELLA DI CASTIGLIA. *Rivista di storia delle scienze mediche* 24, 56-61, 1933. ISIS

Jane, C. The voyages of CHRISTOPHER COLUMBUS. 347 p. London, Argonaut Press, 1932. ISIS

Kahle, Paul. A lost map of COLUMBUS. *Geographical Review* 23, 621-38, 2 fig., 1933. ISIS

"At Constantinople in the autumn of 1929 I had the good fortune to meet Professor A. DEISSMANN." "One day he brought to my attention a number of marine charts recently discovered in the Seraglio, among which was a magnificent colored Turkish map (ca. 86 × 60 cm.) on parchment showing the Atlantic Ocean with its islands and coast lines. One of the legends on this map may be translated as follows:

'The author of this is the poor man PIRI BEN HĀDJI MUHAMMED, who is known as the son of the brother of KEMAL RE'IS, in the town of Gallipoli —may God have mercy on them both—in the holy Muharram of the year 919 [March/April, 1513]'."

"It seems highly probable that the map discovered in the Seraglio is the very map presented by PIRI RE'IS to Sultan SELIM I at Cairo, doubtless in 1517, the year of SELIM's conquest of Egypt. However, in its present form the map is mutilated, comprising only the western portion of an original world map."

"It is clear from his use of PTOLEMY's maps and the Arabic map of India that the whole must have been a map of the world. This is also evident from the mention of the Seven Seas. The startling reference to a map drawn by COLUMBUS is fully confirmed by a critical examination of the northwestern part of PIRI RE'IS' map in comparison with what may be learned from other documents pertaining to COLUMBUS and his first three voyages."

Kahle, Paul. Die verschollene COLUMBUS-Karte von 1498 in einer türkischen Weltkarte von 1513. 52 p., 9 pl. Berlin, DE GRUYTER, 1933. ISIS

Reviewed by RICHARD UHDEN, *DLZ* 4, 1666-71, 1933.

Kimble, George H. Portuguese policy and its influence on fifteenth century cartography. *Geographical Review* 23, 653-59, 1933. ISIS

"One of the most striking anomalies in the cartography of the fifteenth century is the scarcity of map material bearing on African exploration, an anomaly only paralleled by the entire absence of maps of Portuguese origin prior to the year 1500. A satisfactory explanation of this has long eluded the grasp of scholars. It is not that the Lusitanians were unaccustomed to map the newly found lands, for AZURARA refers in his 'Chronicle of the discovery and conquest of Guinea' to the use of such maps. The reason would seem to lie in the field of politics."

Levi della Vida, G. Il regno di Granata nel 1465-66 nei ricordi di un viaggiatore egiziano. *Al-Andalus* 1, 307-34, 1933. ISIS

This Egyptian traveler was 'ABD AL-BĀSIṬ BIN KHALĪL BIN SHĀHĪN AL-MALAṬĪ. G. S.

Salter, F. M. SKELTON's Speculum principis. *Speculum* 9, 25-37, 1934. ISIS

Sayous, André-E. CHRISTOPHE COLOMB, Génois. *Revue historique* 58, 171, 514-21, 1933. ISIS

Thorndike, Lynn. PIETRO RANZANO (d. 1492). Query no. 36. *Isis* 20, 444, 1934. ISIS

Walter, François. Les maladies de la peau figurées au retable de WIT STWOSZ à Notre-Dame de Cracovie. *Aesculape*, 242-55, 14 fig., octobre 1933. ISIS

WIT STWOSZ, 1438-1533.

Zaunick, Rudolph. Das Erfurter Fischbüchlein vom Jahre 1498. *Mitt. z. Gesch. d. Med.* 32, 301-03, 1933. ISIS

XVIth Century (whole and first half)

A. — *Mathematics*

Bortolotti, Ettore. I cartelli di matematica disfida e la personalità psichica e morale di GIROLAMO CARDANO. 79 p. Estratto dal vol. XII degli *Studi e memorie per la storia dell' Università di Bologna*, 1933. ISIS

Cardan, Jerome. The book of my life (De vita propria liber). Translated from the Latin by JEAN STONER. XVIII+331 p. London, DENT, 1931. ISIS

Reviewed by LAO GENEVRA SIMONS, *Scripta mathematica* 2, 50-55, 1933.

B. — *Physical sciences and technology*

Darmstaedter, Ernst. Kurze Bemerkung zu PARACELSUS De Natura Rerum. *Janus* 37, 323-24, 1933. ISIS

Koyré, A. COPERNIC. *Rev. philos.* 116, 101-18, 1933. ISIS

Introduction à une traduction française du De Revolutionibus Orbium Celestium, à paraître chez ALCAN.

Pogo, A. Earliest diagrams showing the axis of a comet tail coinciding with the radius vector. Query no. 35. *Isis* 20, 443, 2 pl., 1934. ISIS

Peeters, F. President HOOVER as a Latinist. Agricola, a chapter in the history of sciences. *Revue du Cercle des Alumni de la Fondation universitaire*, 4, Bruxelles, 1933. ISIS

Zimmer, G. F. The sixteenth century chain pump at Hampton Court. *Transactions of the Newcomen Society* 11, 55-66, 8 fig., 1930-31. ISIS

Zinner, E. NIKOLAUS KOPPERNICK und die Sonnenuhr zu Wloclawek. *Mitt. zur Gesch. d. Med.* 32, 304-06, 1933. ISIS

D. — *Medical sciences*

Eschevannes, Carlos d'. La vie d'AMBROISE PARÉ, père de la chirurgie 1510-1590. Préface de J. L. FAURE. 7e édition, 207 p. (Vies des hommes illustres, 52). Paris, GALLIMARD, 1930. (15 fr.). ISIS

Cette vie romancée ne contient aucun document nouveau et n'ajoute rien à notre connaissance de PARÉ. G. S.

Feyfer, F. M. G. de. JAN STEVEN van Calcar (JOANNES STEPHANUS), 1499-1546. *Bijdragen tot de geschiedenis der geneeskunde* 13, 177-94, 11 fig., 1933. ISIS

Goodall, E. W. Note on the *Liber de Febre Pestilentiali* of NICOLAS MASSA. *Proceedings of the Royal Society of Medicine*, 26, 23-24. London, 1933. ISIS

MASSA's book on the pest, now a scarce item, was published in Venice, 1540, with a second edition in both Latin and Italian in 1556. In it he explains the use of the word " petichiae," a corruption, commonly used in Venice, of the word " pestichiae," from " pestis. " FRACASTOR, who wrote in 1546, used " peticulae," also a corruption.

MASSA also used the expression, " epidemicis constitutionibus," which has usually been attributed to SYDENHAM. There is evidence that SYDENHAM read MASSA's book and took his " epidemic constitution " from this source. H. R. V.

Larkey, Sanford V. The Vesalian compendium of GEMINUS and NICHOLAS UDALL's translation : their relation to VESALIUS, CAIUS, VICARY, and DE MONDEVILLE. Reprinted from the *Transactions of the Bibliographical Society*, 367-94, March 1933. ISIS

This contribution to the study of the Vesalian tradition in England in the sixteenth century is so important that I beg leave to quote its conclusions :

" The Compendium of GEMINUS and the two editions of the English translations were among the most important anatomical works in England of the sixteenth century. They must have been of tremendous value in the study of dissection, as conducted by JOHN CAIUS at the Hall of the Barber-Surgeons Company and in those instituted later at the Royal College of Physicians. They meant that the young surgeons knew their anatomy from the best source, VESALIUS, although the text was so arranged that it could be used in the dissecting room. This was probably a factor in the improved surgery of the Elizabethan period. Further, these works stand as an example of the broad interests of the scholars of early Tudor times. If CAIUS was really connected with the 1545 GEMINUS, this adds lustre to a name already great for its contributions not only to medicine but also to philology and education in general. It shows that he appreciated the importance of careful dissection and makes us realize that the ' anatomies ' he directed were not simply a recital of the old authorities but were really in the spirit of investigation. The versatility of the schoolmaster and dramatist NICHOLAS UDALL is strikingly evident in his grasp of the problem. He realized the value of the illustrations of VESALIUS, but also that the text of the Epitome was not suitable for teaching. His rearrangement of the VICARY text along the lines of MUNDINUS was the form followed in a great many of the later anatomies. This type and the Vesalian Compendia following GEMINUS were the most popular in the sixteenth and seventeenth centuries. UDALL's version, combining these two, possessed the merits of both, and was admirably suited for its purpose. As such, it was the first English dissecting manual. Perhaps we shall never know just what he added to the 1548 VICARY, but there is a literary quality in his treatise that is probably the result of his own genius. His choice of this text shows the high regard for the work of this estimable surgeon of St. Bartholomew's Hospital. It is indeed unfortunate that there is no copy of the earliest version of VICARY, for it would be interesting to compare it with the text of UDALL, the most important link in the long series of editions of VICARY. The value of this book in the spread of the Vesalian anatomy has been emphasized. It contains the only English translation of the descriptions of the drawings in the Fabrica. Although JOHN BANISTER's The historie of man, sucked from the sappe of the most approved Anathomistes, London, 1578 (No. 34), is based on VESALIUS and REALDUS COLUMBUS, he has reproduced only five of the plates from the Fabrica, two of the skeleton, two of muscles, and the instruments for dissection. The entire translation of UDALL is distinguished by its clarity, especially in contrast to the PAYNE manuscript, and should be of interest to students of literature since it provides another example of the work of this forerunner of the great Elizabethans. These books are in every way a delight, bringing before us a picture of the full life of those energetic times."

Lint, J. G. de. Eine der ersten Guajakschriften. Nachschrift. *Janus* 37, 320-22, 1933. ISIS

Paepke, Kurt. Zahnärztliches aus den Werken von AMBROISE PARÉ. Inaugural-Dissertation, Leipzig, 1933, 24 p. ISIS

E. — *Alia*

Routh, E. M. G. Sir THOMAS MORE and his friends. 276 p. frontispiece, 14 pl. Oxford, Clarendon Press, 1933. ISIS

"The book is a study of Sir THOMAS MORE—author of Utopia and one of HENRY VIII's privy councillors—drawn from his own letters and other writings and from those of his personal friends. These sources afford a more intimate account of a many-sided personality than it is possible to find in the case of any other Englishman of his period. Some obscure details of MORE's official life have been brought to light, and special attention is given to his friendships with scholars of the Renaissance and to his services for education. The book is illustrated by a number of portraits many of them taken from drawings by HOLBEIN in the Royal collection at Windsor."

XVIth Century (second half)

C. — *Natural sciences*

Coiter, Volcher. The "De ovorum Gallinaceorum generationis primo exordio progressuque, et pulli Gallinacei creationis ordine" of VOLCHER COITER. Translated and edited with notes and introduction by HOWARD B. ADELMANN. Part II. *Annals of medical history* 5, 444-57, 1933. ISIS

Heawood, Edward. AEGIDIUS TSCHUDI's maps. *Geographical Journal* 81, 39-43, 1933. ISIS

Some fifty maps are among TSCHUDI's manuscripts in the Library of St. Gallen: of these, five sheets cover the British Isles, and are here considered. A date slightly later than 1550 seems indicated. C. W. A.

Nuijens, B. W. Th. Doctor VOLCHER COITER, 1534-1576? Een noordnederlandsche geleerde uit de 16de eeuw. *Bijdragen tot de geschiedenis der geneeskunde* 13, 251-69, 2 pl., 1933. ISIS

D. — *Medical sciences*

Lanselle, M. Un puériculteur oublié: SIMON DE VALLAMBERT. *Bulletin de la societé française d'histoire de la médecine* 27, 243-51, 1933. ISIS

Theunisz, Joh. Het honorarium van PALUDANUS als stadsgeneesheer van Enkhuizen. *Bijdragen tot de geschiedenis der geneeskunde* 13, 239-40, 1933. ISIS

E. — *Alia*

Babinger, Franz. Sherleiana. I. Sir ANTHONY SHERLEY's persische Botschaftsreise (1599-1601). II. Sir ANTHONY SHERLEY's marokkanische Sendung (1605-6). 51 p., 7 ills. Berlin, Reichsdruckerei, 1932. ISIS

Reviewed by Sir E. DENISON ROSS, *Journal of the Royal Asiatic Society*, 970-74, 1933.

Nielsen, Lauritz. Dansk Bibliografi, 1551-1600. Med saerligt hensyn til Dansk bogtrykkerkunsts historie. XLIII+677 p. Kobenhavn. GYLDENKAL, 1931-33. ISIS

Very elaborate bibliography of the books printed in Denmark in the second half of the sixteenth century. G. S.

Ross, Sir E. Denison. Sir ANTHONY SHERLEY and his Persian adventure. Including some contemporary narratives, relating thereto. XXXVIII+293 p. (Broadway Travellers). London, ROUTLEDGE, 1933. ISIS

Reviewed by WILLIAM FOSTER, *Journal of the Royal Asiatic Society*, 209-12, 1934.

XVIIth Century (whole and first half)

A. — *Mathematics*

Jasinski, René. Sur les deux infinis de PASCAL. *R. d'histoire de la philos. et d'hist. génér. de la civilisation* 1, 134-59, 1933. ISIS

B. — *Physical sciences and technology*

Barba, Alvaro Alonso. Arte de los metales en que se enseña el verdadero beneficio de los de oro, y plata por açogue. El modo de fundirlos todos, y como se han de refinar, y apartar unos de otros. Compuesto por el licenciado ALVARO ALONSO BARBA, natural de la villa de Lepe, en la Andaluzia, Cura en la Imperial de Potosi, de la Parroquia de S. Bernardo. Con privilegio. En Madrid. En la Imprenta del Reyno. Año M.DC.XXXX. Consta esta nueva edición de 1000 ejemplares. Está publicada por iniciativa de la Escuela Especial de Ingenieros de Minas de Madrid, e impresa en la casa C. BERMEJO. Santísima Trinidad, 7, Madrid, en 1932. ISIS

Second facsimile edition of this great classic of Spanish-American mining. The first was published in 1925 by the Compañia fundidora de fierro y acero de Monterrey, S.A., of Mexico. The present edition is dedicated to Señor

Don ADOLFO PRIETO Y ALVAREZ, to whose munificence I owe a copy of it. BARBA's work has already been dealt with, apropos of U. J. PAOLI's study of 1922 (*Isis* 4, 468) and of the new English translation by ROSS E. DOUGLAS and E. P. MATHEWSON of 1923 (*Isis* 6, 162); his views on metals have been discussed by HÉLÈNE METZGER (*Isis* 4, 468-70). The present facsimile is preceded by biographical and bibliographical notes. BARBA's Arte de los metales is the fundamental source for the study of the early Hispano-American mining and metallurgy. BARBA was not by any means the discoverer of the amalgamation process (the discovery was made somewhat earlier, probably in Mexico as early as 1566; the earliest technical account is that of JOSEPH DE ACOSTA 1590) but his book contains the best description of the different methods of silver amalgamation, including the so-called Washoe process. It is interesting to note that the amalgamation of silver ores was not introduced into Europe until 1784. See HERBERT HOOVER's Agricola (1912, 297-300; *Isis* 13, 113-6). It gives us special pleasure to praise this beautiful publication because it is due to Mexican initiative. G. S.

Barnes, William H. BROWNE's "Hydriotaphia" with a reference to adipocere. *Isis* 20, 337-43, 1934. ISIS

"Certain passages of some historical interest to chemistry in Sir THOMAS BROWNE's "Hydriotaphia" (1658) are quoted, and a plea is made for the recognition of BROWNE, instead of FOURCROY, as the first discoverer of adipocere."

Gliozzi, Mario. L'elettrologia nel secolo XVII. *Periodico di matematiche* 13, 1-14, 1933. ISIS

Deals mainly with WILLIAM GILBERT (who belongs to the sixteenth century), NICOLA CABEO (1585-1650), NEWTON, OTTO VON GUERICKE, HOOKE, BOYLE. The author concludes "Nel secolo XVII dunque si conobbero molti fenomeni elettrici, ma non si riuscì a collegarli in un corpo di dottrina e, sopratutto, mancarono gli uomini che se ne occupassero non incidentalmente, come risultati secondarî di altre ricerche, ma che di questi fenomeni facessero lo scopo precipuo della loro indagine scientifica: cosa questa che avverrà soltanto nel secolo successivo con le storiche sei Memorie del DU FAY degli anni 1733-34." G. S.

Gliozzi, Mario. Origini e sviluppi dell'esperienza Torricelliana. 84 p. Torino, GIAPPICHELLI, 1931. ISIS

Contents: I precedenti dell'esperienza Torricelliana; L'esperienza Torricelliana; "La grande esperienza"; Prime applicazioni e denominazione del tubo Torricelliano; Lineamenti d'una storia del barometro; Bibliografia.

(Mersenne, Marin). Correspondance du P. MARIN MERSENNE, religieux minime, publiée par Mme PAUL TANNERY, éditée et annotée par CORNELIS DE WAARD, avec la collaboration de RENÉ PINTARD. Vol. 1, 1617-1627. 666 p. Paris, BEAUCHESNE, 1933. ISIS

Reviewed by J. PELSENEER, *Isis* 20, 467-70, 1934; by HARCOURT BROWN, *Romanic Review* 24, 358-60, 1933.

Tannery, Mme Paul. Une lettre inédite de DESCARTES à HUYGENS. *Archeion* 15, 177-80, 1933. ISIS

Tannery, Mme Paul. Une lettre inédite de DESCARTES à HUYGHENS. *Revue scientifique* 71, 481-82, 1933. ISIS

Billet relatif à la taille des verres et daté d'Utrecht 15/25 avril 1635; il aurait dû figurer avec le no. 1 dans l'édition ROTH de la correspondance de DESCARTES avec CONSTANTIN HUYGHENS. J. P.

Tierie, G. CORNELIS DREBBEL (1572-1633). (In English). VII+124 p., ills. Amsterdam, H. J. PARIS, 1932. ISIS

Reviewed by T. L. DAVIS, *Isis* 20, 285-86, 1933.

D. — *Medical sciences*

Andel, Mr A. van. De geneeskundige practijk der 17e eeuw naar titelprenten. *Bijdragen tot de geschiedenis der geneeskunde* 13, 270-73, 2 pl., 241-45, 4 pl., 1933. ISIS

Medical practice as illustrated by the title pages of printed books.

Campailla, Giuseppe. Notizie sulla vita e le opere di TOMMASO CAMPAILLA (1668-1740) sifilografo e biologo siciliano. *Rivista di storia delle scienze mediche* 24, 41-48, 1 ills., 1933. ISIS

Laignel-Lavastine, M.; Vinchon, Jean. La médecine en Perse au XVIIe siècle. *Bulletin de la société française d'histoire de la médecine* 27, 196-212, 1933. ISIS

E. — *Alia*

Adam, Charles. Correspondance de DESCARTES. Nouveau classement. *Rev. philos.* 115, 373-401, 1933. ISIS

Liste complète, ordonnée suivant un ordre strictement chronologique, de toutes les lettres de DESCARTES connues, et de la correspondance DESCARTES-HUYGENS. Cette liste constitue une annexe indispensable à l'édition ADAM-TANNERY. L. G.

Basile, Giambattista. The Pentamerone. Translated from the Italian of BENEDETTO CROCE. Now edited with a preface, notes and appendixes by N. M. PENZER. 2 vols. LXXV+310 p.; VI+334 p., port., frontispiece, ills. London, LANE, 1932. ISIS

Reviewed by D. B. MACDONALD, *Isis* 20, 464-67, 1934.

Gafafer, William M. KENELM DIGBY, seventeenth century psychotherapist. *Human Biology* 5, 506-15, 1933. ISIS

Apropos of DIGBY's sympathetic cure of wounds. G. S.

Humbert, Pierre. Un amateur : PEIRESC (1580-1637). 325 p., 8 pl. Paris, DESCLÉE DE BROUWER, 1933. ISIS

Contents : 1. Le prince d'Amour; 2. Un humaniste en Italie; 3. Le doctorat; 4. Paris, Londres, les Flandres; 5. Astronomica; 6. L'académie putéane; 7. L'abbé de Guîtres; 8. L'estude d'Aix; 9. L'exil à Belgentier; 10. Les correspondants; 11. Un bureau de longitudes; 12. Merveilles de la nature; 13. Panglossie; Notes; Sources et bibliographie; Ouvrages consultés; Notes sur les planches hors texte. G. S.

Reviewed by ADRIEN BLANCHET, *Journal des Savants*, 184-86, 1933; by PIERRE BRUNET, *Archeion* 15, 275-76. 1933.

Pearl, Raymond. TOBIAS VENNER and his Via recta. *Human Biology* 4, 558-83, 5 fig., 1932. ISIS

Apropos of TOBIAS VENNER's (1577-1660) famous treatise on longevity, Via recta ad vitam longam, first published in 1620. Biography, description, analysis, extracts. G. S.

Picard, Emile. Sur le " Discours de la méthode." *La Revue de France*, 14, 55-66, 1934. ISIS

Sturt, Mary. FRANCIS BACON, a biography. XVI+246 p., 12 pl. New York, MORROW, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 286-87, 1933.

XVIIth Century (second half)

B. — *Physical sciences and technology*

Browne, C. A. The two hundred and fiftieth anniversary of chemical industry in America. *Journal of Industrial and Engineering Chemistry* 11, 10 p., 1919. ISIS

Deals largely with JOHN WINTHROP the younger (1606-76), q.v., *Isis* 11, 325-42. G. S.

(Halley, Edmond). Correspondence and papers of EDMOND HALLEY, preceded by an unpublished memoir of his life by one of his contemporaries and the " Eloge " by D'ORTOUS DE MAIRAN. Arranged and edited by EUGENE FAIRFIELD MACPIKE. 300+IX p. Oxford, Clarendon Press, 1932. ISIS

Reviewed by N. T. BOBROVNIKOFF, *Isis* 20, 470-72, 1934.

Lippmann, Edmund O. von. Einige Bemerkungen zu " R. BATHURST, ein unbekannter Vorläufer LAVOISIERS". *Angewandte Chemie* 46, 351, 1933. ISIS

Apropos of RALPH BATHURST (1620-1704), divine and physician, one of the founders of the R. S. " Er erklärte um 1654, laut der im obigen wiederholt angeführten HAESERschen, ' Geschichte der Medizin,' übereinstimmend mit seinen ärztlichen Zeitgenossen, z.B. HENSHAW (1617-1699), als den das Blut rötenden Bestandteil der Luft den ' Grundstoff ' des Salpeters; diese Substanz ist nach ihm, wie eingangs erwähnt, im Salpeter ' fixiert ' vorhanden, in der Luft frei, und bildet das ' pabulum nitrosum,' den nitrösen Nahrstoff, der zur Verbrennung und Atmung dient, daher für Tiere und Pflanzen unentbehrlich ist, so dass auch letztere zugrunde gehen, wenn man sie in ein dunkles Zimmer bringt, also (durch dessen Verschluss !) den Luftzutritt absperrt. Alle diese noch sehr unvollkommenen Vorstellungen sind sichtlich ganz die nämlichen, die sich, an noch ältere anschliessend, bei den mit BATHURST gleichalterigen Fachleuten vorfinden; er vermochte sie weder weiterzubilden noch über ihre Unklarheiten in irgendeinem wesentlichen Punkte hinauszukommen. Hiernach kann er wohl keinen Anspruch auf selbständige Bedeutung erheben, und es scheint nicht gerechtfertigt, ihn als Vorläufer LAVOISIERS anzusehen und als Träger von Gedanken, deren Fortbildung ' geraden Weges zur Theorie LAVOISIERS führte '." G. S.

C. — *Natural sciences*

Cowles, Thomas. Dr. HENRY POWER, disciple of Sir THOMAS BROWNE. *Isis* 20, 344-66, 1934. ISIS

HENRY POWER (1623-68), physician and naturalist. Biography and analysis of his Experimental philosophy (London 1664). Typical extracts are quoted. G. S.

Seters, W. H. van. LEEUWENHOECKS microscopen, praepareeren observatiemethodes. *Bijdragen tot de geschiedenis der geneeskunde* 13, 217-35, 4 pl., 1933. ISIS

D. — *Medical sciences*

Capparoni, Pietro. Le vicende della tomba di GASPARE TAGLIACOZZI. *Rivista di storia delle scienze mediche* 24, 48-56, 1933. ISIS

Gibson, Thomas. An account of Dr. THEODORE TURQUET DE MAYERNE's " Praxis medica," Augsburg, 1691. *Annals of medical history* 5, 438-43, 2 fig., 1933. ISIS

Gladstone, Ethel. JOHANN SIGISMUND ELSHOLTZ (1623-1688). Clysmatica nova (1665): ELSHOLTZ' neglected work on intravenous injection. *California and Western Medicine*, vols. 38-39, 43 p., 6 fig., San Francisco, June to Sept. 1, 1933. ISIS

"A neglected contributor to the interesting experimentation of the seventh decade of the seventeenth century on blood transfusion was JOHANN SIGISMUND ELSHOLTZ, state physician to the Great Elector. While ELSHOLTZ himself did not perform actual transfusions, he nevertheless made important experiments on intravenous injection in animals and in humans, and he discussed quite thoroughly the contemporary problems involved in transfusion." "The *Clysmatica Nova* contains an important discussion of contemporary work on blood transfusion, and presents his own experimental studies on intravenous injection in detail. It is noteworthy that ELSHOLTZ attributes all the interest in this connection to HARVEY's demonstration of blood circulation. Medical historians generally give to the English workers all the credit for experimental work on intravenous injection and blood transfusion. But ELSHOLTZ' report on this subject, which first appeared in 1665, indicates how widespread interest in this field really was. Extensive comment might be made on various aspects of ELSHOLTZ' discussion, but it speaks well enough for itself. A translation of the second edition of the *Clysmatica Nova*, with its quaint illustrations, is offered herewith." (From the introduction by C. D. LEAKE).

Haberling, Wilhelm. Neues aus dem Leben und Wirken JOHANN CONRAD BRUNNERS (geb. 1653). *Mitt. zur Gesch. d. Med.* 32, 298, 1933. ISIS

Kranenburg, W. R. H. BERNARDINUS RAMAZZINI, 1633-1933. *Bijdragen tot de geschiedenis der geneeskunde* 13, 196-200, 2 fig., 1933. ISIS

Lanselle, M. Notes sur un hôpital militaire au temps de LOUIS XIV. *Bulletin de la société française d'histoire de la médecine* 27, 224-28, 1933. ISIS

Ramazzini, Bernardino (1633-1714). Diseases of tradesmen, together with biographical notes translated from the French by FRANÇOIS CLAUDE MAYER (1928) and paragraphs from the preface of Dr. JAMES (1746) of London and of Dr. JAMES (1922) of New York. Compiled and abstracted by HERMAN GOODMAN. New York, Medical Lay Press, 1933. ISIS

Abstracts from the 1746 English translation of RAMAZZINI, chiefly dermatological. With it is bound Silk Handlers' Disease of the Skin by HERMAN GOODMAN. S. V. L.

Rudbeck, Olaf (1630-1702). Nova excercitatio anatomica, exhibens ductus Hepaticos aquosos, & vasa glandularum serosa, nunc primum inventa, aeneisque figuris delineata, ab OLAO RUDBECK Sveco. Arosia, EUCHARIUS LAURINGERUS, MDCLIII. Facsimile reprint, Uppsala, ALMQVIST & WIKSELL, 1930. ISIS

Beautiful facsimile edition of this anatomical classic of 1653 published by the medical profession of Upsala to celebrate the third centenary of RUDBECK's birth. The *Nova exercitatio* contains a description of the lymphatic system which RUDBECK discovered (1651) before BARTHOLIN, though the latter's publication was anterior (1652). It describes the lacteals (vasa serosa, as he calls them) and their connection with the thoracic duct, the lymphatic glands and the lymphatic fluid, and tries to explain their significance. G. S.

E. — *Alia*

Brown, Harcourt. Un cosmopolite du grand siècle : HENRI JUSTEL. *Bulletin de la société de l'histoire du protestantisme français* (avril-juin 1933). 15 p. Paris, 1933. ISIS

Notes completing Dr. DALLY's paper in the same *Bulletin* (1930, p. 9). The Frenchman, HENRI JUSTEL (1620-93) was librarian of St. James Palace in 1681-8; he took an active part in the Franco-English intellectual exchanges. G. S.

Gafafer, William M. JOSEPH GLANVILL, a forgotten seventeenth century iconoclast. *Human Biology* 4, 121-30, 1932. ISIS

Synopsis of and extracts from the *Scepsis scientifica* (London 1665) which was a revised edition of *The vanity of dogmatizing* (London 1661), lately reproduced in facsimile in New York. GLANVILL " dedicated himself primarily to the destruction of the scientific and religious dogmatism that prevailed in England during the first half of the seventeenth century. His mind revolted not only from the dogmatism which found all wisdom within the covers of ARISTOTLE's works, but also, no less from that form of dogmatism which flew to the opposite extreme. GLANVILL was a genuine sceptic. According to him « sceptics seek truth in the book of nature, and in that search proceed with wariness and circumspection without too much forwardness in establishing maxims and positive doctrines; their opinions are proposed as hypotheses that may probably be the true accounts without peremptorily affirming that they are. » G. S.

Glanvill, Joseph (1636-80). The vanity of dogmatizing. Reproduced from the edition of 1661. With a bibliographical note by MOODY E. PRIOR. 38+250 p. Published for the Facsimile Text Society by Columbia University Press, New York, 1931. ISIS

Very elegant facsimile of the first edition of a book which the historian of the scientific thought of that period must take into account. GLANVILL became F.R.S. at the end of 1664. A second edition of this, his first work, appeared in 1665 with a new title, *Scepsis scientifica : or, Confest ignorance the way to science*, and with various omissions and additions, e.g., a long dedicatory epistle to the R.S. Following the main treatise in the second edition is added a reply to THOMAS WHITE's *Sciri, sive sceptices & scepticorum à jure disputationis exclusio* (1663), which had attacked *The vanity of dogmatizing*. A third edition with many other changes appeared in 1676.

The main part of the second edition was reprinted in London 1885 with an introduction by JOHN OWEN. This is thus the fifth edition. G. S.

Levy, J. An unknown portrait of SPINOZA. *The Connoisseur*, 90, 317-20, 6 ill. London, Nov. 1932. ISIS

Portrait by SAMUEL VAN HOOGSTRAATEN (1627-78) in the private possession of a Berlin resident. G. S.

Young, R. Fitzgibbon. Universalism and nationalism in Germany. *Times Literary Supplement*, p. 44, London, Jan. 18, 1934. ISIS

Apropos of the foundation in 1667 of the Universitas Brandenburgica gentium scientiarum et artium.

XVIIIth Century (whole and first half)

A. — *Mathematics*

Archibald, Raymond Clare. ROBERT SIMSON (1687-1768) and CANTOR's Vorlesungen. *Scripta mathematica* 2, 73-75, 1933. ISIS

Deming, W. Edwards. DE MOIVRE's "Miscellanea analytica," and the origin of the normal curve. *Nature* 132, 713, 1933. ISIS

Apropos of the text published in facsimile by R. C. ARCHIBALD (*Isis* 8, 671-83, 1926). G. S.

(Euler). LEONHARD EULER's Elastic curves (De curvis elasticis, additamentum I to his Methodus inveniendi lineas curvas maximi minimive proprietate gaudentes, Lausanne and Geneva, 1744). Translated and annotated by W. A. OLDFATHER; C. A. ELLIS, and D. M. BROWN. *Isis* 20, 72-160, 4 pl., 1933. ISIS

English translation with introduction and notes of EULER's famous treatise De curvis elasticis appended to his Methodus inveniendi lineas curvas maximi minimive proprietate gaudentes (Lausanne 1744).

Volterra, Vito. DE MOIVRE's "Miscellanea analytica." *Nature* 132, 898, 1933. ISIS

Watson, C. N. The marquis and the land-agent : a tale of the eighteenth century. *Mathematical Gazette*, 17, 6-17, 1933. ISIS

Presidential address to the Mathematical Association; outlining the work of the marquis, GIULIO CARLO DI FAGNANO (Senigallia 1682.9.26—Senigallia 1766.5.18) on elliptic and other arcs, which led up to the theory of elliptic functions. C. W. A.

B. — *Physical sciences and technology*

Althin, Torsten. Memorial to MÅRTEN TRIEWALD. *Transactions of the Newcomen Society* 11, 163, 1930-31. ISIS

"The first atmospheric steam engine, i.e., on the NEWCOMEN system, in Sweden was started at the famous Dannemora mines in the year 1728. Nothing of the original steam engine is preserved to our days except the stone building which formerly enclosed the engine. In remembrance of this old engine and of MÅRTEN TRIEWALD, the famous Swedish scientist, the man who had the greatest importance for its erection, the Tekniska Museet, Stockholm, resolved to erect a memorial tablet on the engine house."

Bootsgezel, J. J. JOHN CALLEY, the partner of THOMAS NEWCOMEN. *Transactions of the Newcomen Society* 11, 135-37, 1930-31. ISIS

Brunet, Pierre. Un grand débat sur la physique de MALEBRANCHE au XVIII[e] siècle. *Isis* 20, 367-95, 1934. ISIS

Important contribution to the study of Cartesianism vs. Newtonianism in France, a subject which the author has made peculiarly his own, witness his *Maupertuis* (1929, *Isis* 15, 177-9) and his *Introduction des théories de Newton en France avant* 1738 (1931, *Isis* 17, 433-5), not to speak of shorter writings. G. S.

Gliozzi, Mario. Progressus de electricitate in anno 1733. *Schola et vita* 8, 105-11, 1933. ISIS

Apropos of CHARLES DU FAY's Mémoires of the year 1733. G. S.

Gliozzi, Mario. Studio comparativo delle teorie elettriche del NOLLET, del WATSON e del FRANKLIN. *Archeion* 15, 202-15, 1933. ISIS

C. — *Natural sciences*

Färber, Eduard. MAGNAL, fl. 1709 and the use of dyes to detect physiological functions. Query no. 37. *Isis* 20, 445, 1934. ISIS

Hulth, J. M. Uppsala Universitetsbiblioteks förvärv av Linneanska originalmanuskript. Uppsala Universitets Biblioteks Minnesskrift 1621-1921, 407-24, Uppsala, ALMQUIST & WIKSELL, 1921. ISIS

(Linnaeus). A catalogue of the works of LINNAEUS (and publications more immediately relating thereto). Preserved in the libraries of the British Museum (Bloomsbury) and the British Museum (Natural history), South Kensington. Second edition. XI+246+68 p., 7 pl. London, British Museum, 1933. ISIS

Reviewed in *Nature* 132, 911-12, 1933.

D. — *Medical sciences*

Battistini, Mario. ANTONIO COCCHI in Belgio ed in Olanda nel 1726. *Rivista di storia delle scienze mediche naturali* 24, 143-48, 1933. ISIS

Cangemi, Filippo Buttà. Il piano di organizzazione e di ditesa sanitaria nell'epidemia di peste del 1624 a Naso (prov. Messina). *Rivista di storia delle scienze mediche e naturali* 24, 172-75, 1933. ISIS

Greenwood, Major. JOHN FREIND (1675-1728). *Janus* 37, 193-210, 1933. ISIS

Schaefer, Günther-Klaus. Die elektro-therapeutische Behandlung im 18. Jahrhundert unter besonderer Berücksichtigung der Zahnheilkunde. 24 p. Inaugural-Dissertation. Institut für Geschichte der Medizin an der Universität Leipzig, 1932. ISIS

XVIIIth Century (second half)

A. — *Mathematics*

Heyman, Harald J. SAMUEL KLINGENSTIERNA och FREDRIK MALLET. Symbola litteraria Hyllningsskrift till Uppsala Universitet, 187-209, Uppsala, ALMQVIST & WIKSELL, 1927. ISIS

Apropos of the Swedish mathematicians SAMUEL KLINGENSTIERNA (1698-1765) and FREDRIK MALLET (1728-97). G. S.

Loria, Gino. JOHANN TOBIAS MAYER comme géomètre. Query no. 31. *Isis* 20, 441, 1934. ISIS

B. — *Physical sciences and technology*

Bland, Fred. JOHN CURR (1756-1823). Originator of iron tram roads. *Transactions of the Newcomen Society* 11, 121-30, 2 fig., 1930-31. ISIS

Brindley, W. H. RICHARD KIRWAN, F.R.S., 1733-1812. *Nature* 132, 957-58, 1933. ISIS

Browne, C. A. Presentation of JOSEPH PRIESTLEY portrait. *Journal of Industrial and Engineering Chemistry* 13, 4 p., 1 port., 1921. ISIS

Browne, C. A. THOMAS PAINE's theory of atmospheric contagion and his account of an experiment performed by GEORGE WASHINGTON upon the production of marsh gas. *Journal of Chemical Education* 2, 99-101, 1925. ISIS

Jenkins, Rhys. JONATHAN HORNBLOWER (1753-1815) and the compound engine. *Transactions of the Newcomen Society* 11, 138-55, 1930-31. ISIS

Lippmann, Edmund O. von. Auch ein Mittel zur Verbilligung des Zuckers ! Erinnerung an alte Zeiten. *Die Deutsche Zuckerindustrie*, Nr. 41, 803, 1933. ISIS

Loewenfeld, Kurt. ERNST FLORENS FRIEDRICH CHLADNI (Skizze von Leben und Werk) (1756-1827). *Abhdl. aus dem Gebiete der Naturwissenschaften*, Bd. 22, 117-44, 3 pl., 1 fig. Hamburg, Naturwissenschaftlicher Verein, 1929. ISIS

Matignon, V. PRIESTLEY et son œuvre scientifique. *Revue scientifique*, 71, 385-96, 1933. ISIS

McKie, Douglas ; Walker, W. Cameron. The " Leeds portrait " of JOSEPH PRIESTLEY. *Nature* 132, 643, 1933. ISIS

Meldrum, A. N. LAVOISIER's early work in science, 1763-1771. *Isis* 20, 396-425, 2 fig., 1934. ISIS

Contents : Part III. Introduction; 1. LEROY on the nature of water; 2. LAVOISIER's work on the nature of water : its origin; 3. LAVOISIER's experiments; 4. LAVOISIER's memoir : the delayed reading; 5. LAVOISIER's memoir : the different versions; 6. The sequel; Conclusion; Index : Names of persons.

Richet, Charles. Discours présidentiel à la séance annuelle du 11 décembre 1933 de l'Académie des sciences. 16 p. Paris, GAUTHIER-VILLARS, 1933. ISIS

La partie la plus intéressante de ce beau discours c'est celle (p. 10-16) consacrée à un arrière-grand-père de l'auteur, PIERRE SIMON GIRARD (Caen 1765-1836) mathématicien, ingénieur, et l'un des membres de cette extraordinaire phalange de savants que BONAPARTE amena en Égypte : MONGE, FOURIER, BERTHOLLET, DOLOMIEU, MALUS, SAVIGNY, GEOFFROY SAINT HILAIRE, DESGENETTES, LARREY, GIRARD ! Il fut l'un des auteurs de l'ouvrage magnifique que NAPOLÉON consacra à l'Égypte, et dont on ne peut feuilleter les immenses in-folios sans émotion quand on songe aux circonstances héroïques dans lesquelles ils furent conçus et donnés au monde. G. S.

Schimank, Hans. JOHANN WILHELM RITTER (1776-1810). *Mitt. z. Gesch. d. Med.* 32, 303, 1933. ISIS

Schimank, Hans. JOHANN WILHELM RITTER, der Begründer der wissenschaftlichen Elektrochemie. Ein Lebensbild aus dem Zeitalter der Romantik. Deutsches Museum, Abhandlungen und Berichte, 5, H. 6, 175-203, 6 fig., 1933 (RM 0.90). ISIS

Short biography of this great German physicist and electrochemist; born in 1776, died prematurely in 1810. With chronological summary, bibliography, illustrations, but no portrait. G. S.

Titley, Arthur. Cornish mining. Notes from the account books of RICHARD TREVITHICK, senior. *Transactions of the Newcomen Society* 11, 26-41, 1930-31. ISIS

C. — *Natural sciences*

Chevalier, Aug. MICHEL ADANSON, précurseur du lamarckisme. *C. R. Acad. des sc.*, 196, 1919-21, 1933. ISIS

Dès 1763 (Les familles de plantes, t. I, p. cxij), alors que " LAMARCK était encore un jeune homme de 20 ans, ignorant encore probablement presque tout des sciences naturelles, ADANSON avait eu une conception très nette du transformisme et même de l'hérédité des caractères acquis." Quand LAMARCK " aborda, à 28 ans, en 1772, l'étude de la botanique au Jardin du Roi, il utilisa souvent les Familles de plantes d'ADANSON qui l'y avait précédé, et il dut dès ce moment s'imprégner de ses idées pour les mûrir et les approfondir par la suite." L. G.

Jenkins, Rhys. FRANCIS THOMPSON's visit to the Cardiganshire mines in 1788. *Transactions of the Newcomen Society* 11, 156-62, 1930-31. ISIS

Molsbergen, E. C. Godée (editor). Reizen in Zuid-Afrika in de Hollandse tijd. Vierde Deel. Tochten in het Kafferland, 1776-1805. XXXII+366 p. 's-Gravenhage, NIJHOFF, 1932. ISIS

Reviewed by G. WATERHOUSE, *Geographical Journal* 91, 266-67, 1933. Inland expeditions of HENDRIK SWELLENGREBEL 1776, Governor VAN PLETTENBERG 1778, Governor JANSSENS 1803, and Commissary-General DE MIST 1803-04; an account of the Kaffirs by FRANZ CARL PHILIPP, Freiherr VON WINCKELMANN, and another of the Cape Hottentots by JAN WILLEM DE GREVENBROECK. C. W. A.

D. — *Medical sciences*

Abraham, James Johnston. LETTSOM: his life, times, friends and

descendants. XX+498 p. London, HEINEMANN, 1933. ISIS
Reviewed in *Nature* 132, 948-49, 1933.

Bodman, Fr. The contribution to medicine made by SAMUEL HAHNEMANN. *Janus* 37, 247-56, 1933. ISIS

Keevil, J. J. WILLIAM ANDERSON, 1748-1778. Master surgeon, Royal Navy. *Annals of Medical History* 5, 511-24, port., 1933. ISIS

Milt, B. FRANZ ANTON MESMER. *Archiv für Geschichte der Medizin* 26, 334-40, 1933. ISIS

Petzoldt, Ernst. SEBASTIAN GOLDWIZ's Versuche zu einer Physiologie der Galle aus dem Jahre 1785. Inaugural-Dissertation. 45 p. (Aus dem Institut für Geschichte der Medizin an der Universität Leipzig). Leipzig, ALEXANDER EDELMANN, 1932. ISIS

"Wenn wir diese Entwicklung der Physiologie betrachten und versucht haben, die Theorien von HALLER, GOLDWIZ und der Gegenwart zu vergleichen, so ist der Wert des Goldwizschen Buches nur ein geringer in rein wissenschaftlicher Hinsicht. Der Wert des Goldwizschen Versuches besteht aber hauptsächlich darin, dass er durch seine Zweifel an der Richtigkeit der damaligen Theorien, die ihm durch seine Praxis kamen, sich veranlasst sah, Licht zu suchen, ' beherzt gegen seine Vorgänger auftreten ' zu müssen glaubte, ' wenn man durch überwiegende Erfahrungen eine Sache als wahrer darlegen kann.' ' Ich warf nun alle Ideen, die ich von der Galle hatte, hinweg und fing an, selbst zu versuchen.' Er hat dabei an sich selbst den Massstab des Kritikers angelegt, und dies oft sehr scharf und mit grösster Gewissenhaftigkeit. Sein Werk hat heute nur historischen Wert."

Rolleston, Sir Humphry. The two HEBERDENS: WILLIAM HEBERDEN THE ELDER (1710-1801); WILLIAM HEBERDEN THE YOUNGER (1767-1845). *Annals of Medical History* 5, 566-83, 2 fig., 1933. ISIS

Rolleston, J. D. WILLAN and BETEMAN on fevers. *British Journal of Dermatology*, Oct. 1933. ISIS
Reviewed in *Nature* 132, 816, 1933. ROBERT WILLAN (1757-1812).

Weir, Sir John. SAMUEL HAHNEMANN and his influence on medical thought. *Proceedings of the Royal Society of Medicine* 26, 24-32, London, 1933. ISIS

Zanco, Fanny Fontana. Una lettera inedita di VINCENZO MALACARNE sul Gozzismo. Atti della società italiana di storia delle scienze mediche e naturali, 82-88, 1 pl., 1933 (appended to *Rivista di storia delle scienze mediche e naturali* 24, 1933). ISIS

E. — *Alia*

Deutsch, Adolf. GOETHE und kein Ende. 21 p. *Westdeutsche Ärzte-Zeitung*, 23. Jhrg., 1932. ISIS

"Die Abhandlung geht von GOETHES Arbeiten zur Morphologie aus. Sie untersucht ihre Wirkung auf verschiedene Zeitalter, ihren Zusammenhang mit GOETHES geistiger Gesamtanlage und mit seiner viel zu wenig beachteten kritischen Einstellung zur Sprache. Sie setzt sich nach diesen Betrachtungen mit den immer wiederkehrenden Versuchen auseinander, GOETHE den Romantikern und Naturphilosophen zuzuzählen. So erscheint das Bild des Naturforschers GOETHE im Spiegel dreier Geschlechter, 'bewundert viel und viel gescholten,' ganz begriffen nur von dem, der seiner Eigenart willig nachgeht, ihren Kräften und ihren Grenzen."

Fischer, Paul. GOETHES letztes Lebensjahr. VIII+171 p., 9 pl. Weimar, BÖHLAUS, 1931. ISIS

Reviewed by K. K. EBERLEIN, *DLZ* 4, 2334-35, 1933.

Franz, Viktor. GOETHES Zwischenkieferpublikation nach Anlass, Inhalt und Wirkung. Mit Ausblicken auf GOETHES Morphologie überhaupt. *Ergebn. Anat.* 30, 469-543, 5 fig., 1933. ISIS

Gafafer, William. M The inhabitants of the Island of St. Kilda and acute upper respiratory disease. *Human Biology* 3, 437-41, 1931. ISIS

Apropos of the mysterious disease reported by KENNETH MACAULAY (1723-79), Lord M's grandfather, in The History of St. Kilda (London 1764). G. S.

(Goethe). GOETHES Briefwechsel mit HEINRICH MEYER. Hrsg. v. MAX HECKER. Bd. 4 : Register zu Bd. 1-3, 352 p. (Schriften d. Goethe-Ges., 35). Weimar, Goethe-Gesellschaft, 1932. ISIS

(Goethe). Helmholtz, Hermann von ; Dohrn, Max ; Schiff, Julius. GOETHES naturwissenschaftliches Denken und Wirken. Drei Aufsätze hrsg. von der Schriftleitung der Zeitschrift *Die Naturwissenschaften*. 99 p., pl. Berlin, SPRINGER, 1932. ISIS

Reviewed by ERNST WOLF, *Isis* 20, 287-90, 1933.

Hubert, René. Introduction bibliographique à l'étude des sources de la science ethnographique dans l'Encyclopédie. *R. d'histoire de la philos. et d'hist. génér. de la civilisation*, 1, 160-72, 1933. ISIS

Suite des études consacrées par R. HUBERT à l'Encyclopédie (Voir *Isis* 7, 228-29). L. G.

Keudell, Elise von. GOETHE als Benutzer der Weimarer Bibliothek. Ein Verzeichnis der von ihm entliehenen Werke. Hg. mit einem Vorwort v. WERNER DEETJEN. XIII+391 p. Weimar, BÖHLAUS, 1931. ISIS

Reviewed by ERNST BEUTLER, *DLZ* 5, 22-23, 1934.

Reichenbach, Hans. KANT und die Naturwissenschaft. *Die Naturwiss.* 21, 602-06, 624-26, 1933. ISIS

Riesman, David. The most interesting newspaper in the United States. The Ulster County Gazette of January 4, 1800. *Annals of Medical History* 5, 197-201, 1933. ISIS

Sarton, George. Le Prospectus de l'Encyclopédie (1750). (Query no. 26). *Isis* 20, 264, 1933. ISIS

Stein, Robert. Der Erfurter Statthalter VON DALBERG als Naturforscher. *Mitt. z. Gesch. d. Med.* 32, 297, 1933. ISIS

Walden, Paul. GOETHE und die Naturwissenschaften. 53 p. (Bremer Beiträge zur Naturwissenschaft, 1). Bremen, VON HALEM, 1933. ISIS

Zekert, Otto. GOETHE und die Chemie. *Pharm. Monatshefte* 19 p., 1933. ISIS

XIXth Century (whole and first half)

A. — *Mathematics*

Neville, E. H. A bibliographical note. *Mathematical Gazette* 17, 200-01, 1933. ISIS

On the title dates of LEGENDRE's Exercises de Calcul intégral and Traité des fonctions elliptiques. C. W. A.

Prasad, Ganesh. Some great mathematicians of the nineteenth century: their lives and their works in three volumes. Vol. 1. With six portraits (GAUSS, CAUCHY, ABEL, JACOBI, WEIERSTRASS, RIEMANN). XV+347 p. Printed by S. C. CHATTERJI, at the Mahamandal Press, Benares City (India), and published by the Benares Mathematical Society, 1933. ISIS

" The present volume, which is the first of the three volumes of my book and which deals with GAUSS, CAUCHY, ABEL, JACOBI, WEIERSTRASS and RIEMANN, six men who are universally accepted as the first six among the

greatest mathematicians of the 19th century, is based on the six lectures which I delivered at the Calcutta University in January, February, March and April of 1932. In writing this volume, my aim has been to place before the minds of the readers the highest types of mathematicians, so that not only every young and accomplished mathematical scholar of to-day but also the budding mathematical genius of the future may strive to attain to the highest ideal of mathematical scholarship and research. Vol. 2, which deals with CAYLEY, HERMITE, BRIOSCHI, POINCARÉ, KLEIN and five others, is ready for the Press. Vol. 3 will be on some of the great living mathematicians. In preparing the present volume, I have made use of a large number of writings of a historical and critical character, in addition to the collected works of the six mathematicians. Many of these writings have been quoted in this volume. But it gives me great pleasure to express here my special obligations to KLEIN's *Vorlesungen ueber die Entwicklung der Mathematik im 19. Jahrhundert*; KOENIGSBERGER's Festschrift, *Gustav Jacob Jacobi*. BJERKNES's *Niels-Henrik Abel: Tableau de sa vie et de son action scientifique*; and the articles of MITTAG-LEFFLER on WEIERSTRASS in various volumes of the *Acta Mathematica*."

B. — *Physical sciences and technology*

Bénézé, G. Note sur l'expérience de FOUCAULT. *R. Philos.* 116, 274-78, 1933. ISIS

Carnegie, Francis. MAUDSLAY centenary address. *Transactions of the Newcomen Society* 11, 168-70, 1930-31. ISIS

A propos of HENRY MAUDSLAY (1771-1831). G. S.

(Faraday, Michael). FARADAY's diary. Being the various philosophical notes of experimental investigation made by MICHAEL FARADAY D.C.L., F.R.S. during the years 1820-1862 and bequeathed by him to the Royal Institution of Great Britain. Now, by order of the Managers, printed and published for the first time, under the editorial supervision of THOMAS MARTIN, with a foreword by Sir WILLIAM H. BRAGG. Vol. I, Sept., 1820-June 11, 1832. Vol. 2, Aug. 25, 1832-Feb. 29, 1836. XXVIII+430 p., 2 pl., figs.; XVII+467 p., 2 pl., figs. London, BELL, 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 472-74, 1934.

Finch, J. K. JOHN BLOOMFIELD JERVIS (1796-1885) civil engineer. *Transactions of the Newcomen Society* 11, 109-20, 1930-31. ISIS

Oldham, Frank. THOMAS YOUNG, F.R.S. Philosopher and physician. 159 p., 14 fig., port. London, ARNOLD, 1933 (6 s.). ISIS

Though this account does not include any unpublished materials and even does not include all the published materials already available (e.g., in

French), it is convenient and very readable. It is divided into two parts : 1. Life;2. Writings; the second part being subdivided as follows : Early publications; The mechanism of the eye; Lectures on natural philosophy (1807); Discoveries in physical optics; Contemporary criticism of Dr. YOUNG's work on optics; Capillarity—YOUNG a modern physicist; Researches in the Egyptian hieroglyphics. G. S.

Ricketts, Palmer C. AMOS EATON, author, teacher, investigator : the first laboratories for the systematic individual work of students in chemistry, physics and botany, to be created in any country, established at Rensselaer School by AMOS EATON in 1824 : B. FRANKLIN GREENE and the reorganization in 1849-50. 32 p., 3 port., ills. Troy, N. Y., Rensselaer Polytechnic Institute, 1933. ISIS

Trevithick, Richard (1771-1833). TREVITHICK centenary commemoration. *Isis* 20, 445-46, 1934. ISIS

Warren, J. G. H. JOHN NUTTALL's sketch book with notes on wrought iron details and wheels for early locomotives. *Transactions of the Newcomen Society* 11, 67-89, 1930-31. ISIS

Wruble, Milton. Studies in percolation. *American Journal of Pharmacy* 105, 24 p., figs., 1933. ISIS

Contents : 1. RÉAL's " Filtre-presse ' and its modifications; 2. ROMERSHAUSEN's " Luft "- and " Dampf-Presse "; 3. The contributions of BOULLAYS, père et fils; 4. Early developments in the United States.

C. — *Natural sciences*

Adams, Frank Dawson. Sir CHARLES LYELL. His place in geological science and his contributions to the geology of North America. *Science* 78, 177-83, 1933. ISIS

Debenham, Frank. Names on the Antarctic continent. *Geographical Journal* 81, 145-48, 1933. ISIS

Dealing with the claim of CHARLES WILKES that he outlined a continental coast in 1840. C. W. A.

Hobbs, William Herbert. The Eastern landfalls of WILKES within the Australian sector of the Antarctic. *Geographical Journal* 81, 538-40, 1933. ISIS

Hobbs, William Herbert. Discovery of a new sketch of Cape Hudson

in the Antarctic. *Geographical Review* 24, 115-17, 2 fig., 1934. ISIS

Innocenti, Giulia degli. Le risorse minerarie toscane nel " Viaggio mineralogico " di G. GIULI. *Rivista di storia delle scienze mediche e naturali* 24, 165-71, 1933. ISIS

Mill, Hugh Robert. The first London professor of geography. *Geographical Journal* 81, 536-38, 1933. ISIS

Captain ALEXANDER MACONOCHIE held the post 1833-35. C. W. A.

D. — *Medical sciences*

Bilancioni, Guglielmo. GIACOMO MAZZINI (1767-1848) padre del grande patriota studioso dell'anatomia patologica dell'orecchio. *Rivista di storia delle scienze mediche* 24, 21-40, 3 fig., 1933. ISIS

Currie, Andrew S. ROBERT KNOX (1791-1862) anatomist, scientist, and martyr. *Proceedings of the Royal Society of Medicine*, 26, 1-8, London, 1932. ISIS

A new and sympathetic reading of the Edinburgh anatomist and his relations with BURKE and HARE, the body-snatchers. Although no new material is presented, this study gives added weight to KNOX's position as a distinguished scientist. H. R. V.

Dock, George. LARREY and mediate auscultation. *Annals of Medical History* 5, 601-02, 1933. ISIS

Munster, Ladislaus. Ein vergessener Vorkämpfer der Parasitenlehre : AGOSTINO BASSI aus Lodi. (Zugleich ein Vergleich der Tätigkeit BASSIS, LISTERS und SEMMELWEIS's und ein Rückblick auf die Entwicklung des Gedankens über Contagium animatum). *Janus* 37, 221-46, 1 pl., 1933. ISIS

Riegel, Robert E. The introduction of phrenology to the United States. *American Historical Review* 39, 73-78, 1933. ISIS

Ruhräh, John. WILLARD PARKER. *Annals of Medical History* 5, 458-83, 3 fig., 1933. ISIS

Schaefer, Romanus Johannes. MARIANNE THEODORE CHARLOTTE HEIDENREICH VON SIEBOLD und ihre Zeit. *Mitt. z. Gesch. d. Med.* 32, 301, 1933. ISIS

Thomson-Walker, Sir John. JOHN GREEN CROSSE, of Norwich. *Proceedings of the Royal Society of Medicine*, 26, 9-16, London, 1933. ISIS

The notebooks and letters of this surgeon, who lived in Norwich, England, from 1790 to 1850, have been preserved. They include notes on the teaching of anatomy and surgery in London in the early nineteenth century by CHARLES BELL, ABERNETHY, ASTLEY COOPER, HOME, POTTS and others. He also describes contemporary Paris physicians. A supporter of JENNER and vaccination, he reported on an epidemic of smallpox in Norwich in 1819. CROSSE's principal interest was in calculus of the bladder. He collected notes on this subject for thirty years and published a monograph in 1835, illustrated by his own drawings. All of CROSSE's manuscripts, thirty-eight volumes in all, have now been deposited in the Library of the Royal Society of Medicine, London. H. R. V.

Torkomian, Vahram H. Un ancien diplôme de la faculté de médecine de Pise. *Bulletin de la société française d'histoire de la médecine* 27, 304-09, 1933. ISIS

A propos du docteur arménien SEROPÉ VICENIAN, alias SERVICEN (M.D., Pise 1840) qui mourut à Constantinople à l'âge de 82 ans en 1897. G. S.

Turner, Roy H. Graefenberg, the SHEPARD family's medical school. *Annals of Medical History* 5, 548-60, 5 fig., 1933. ISIS

" Alabama's first medical school was a family institution. It was located in an isolated rural community which only a few years before had been the hunting ground of Indians. The story of the school and its founder throws light on a distinctive period in American history, the medical, social and economic aspects of which were characterized by unbounded energy and enthusiasm but frequently by total disregard for sound principles."

Viets, Henry R. OLIVER WENDELL HOLMES, physician. *The American Scholar* 3, 7 p., port., 1934. ISIS

Walkling, Adolph A. HENRY INGERSOLL BOWDITCH (1808-92). *Annals of Medical History* 5, 428-37, 2 fig., 1933. ISIS

Zeiss, Heinz. Die Medizinische Zeitung Russlands (1844 bis 1860). Ein Beitrag zur Geschichte des ausländischen ärztlichen Schrifttums. *Mitteilungen z. Gesch. d. Med.*, 32, 295, 1933. ISIS

E. — *Alia*

Collard, Auguste. GOETHE et QUETELET. Leurs relations de 1829 à 1832. *Isis* 20, 426-35, 1934. ISIS

Gouhier, Henti. Le premier maître d'AUGUSTE COMTE : DANIEL

ENCONTRE. *R. d'hist. de la philos. et d'hist. générale de la civilisation* 1, 76-93, 1933. ISIS

DANIEL ENCONTRE (1762-1818), professeur de mathématiques transcendantes au lycée de Montpellier.

XIXth Century (second half)

A. — *Mathematics*

Buhl, A. L'école de CHARLES HERMITE et la physique théorique. *Revue scientifique* 71, 545-50, 1933. ISIS

Conta, Vasile (1846-1882). Rumanian mathematician. Obituary by PETRE SERGESCU, *Gazeta matematica* no. 3, 3 p., 1932. ISIS

Eperson, D. B. LEWIS CARROLL — mathematician. *Mathematical Gazette* 17, 92-100, 1933. ISIS

C. L. DODGSON (1832-1898) mathematical lecturer, Oxford, 1855-1881. C. W. A.

Hill, Lester S. FRAENKEL's biography of GEORG CANTOR. *Scripta mathematica* 2, 41-47, 1933. ISIS

(Painlevé, Paul). Articles par VICTOR BASCH, PAUL LANGEVIN et FERNAND BOUISSON. *Les Cahiers des droits de l'homme*, 33, 651-65, 1933. ISIS

(Painlevé, Paul). *Les cahiers rationalistes*, no. 26, 230-60, 1933. ISIS

B. — *Physical sciences and technology*

Bougault, J. ; Cattelain, E. Notice sur la vie et les travaux de ANTOINE VILLIERS MORIAMÉ (1834-1932). *B. Soc. chim. de France*, 53/54, I-II, portr., 1933. ISIS

A. VILLIERS-MORIAMÉ, professeur à la faculté de pharmacie de l'université de Paris; travaux de chimie organique et surtout de chimie analytique. L. G.

Crompton, R. E. B. The first installation of house-to-house (electric) supply in the United Kingdom. *Transactions of the Newcomen Society* 11, 90-97, 1930-31. ISIS

Orrok, Geo. A. Pearl Street station. The first (electric) central station in the world. *Transactions of the Newcomen Society* 11, 98-108, 1930-31. ISIS

Picard, Emile. La vie et l'œuvre de JOSEPH BOUSSINESQ (1842-1929). 43 p., portr. (Lecture faite en la séance annuelle du 11 décembre 1933). Paris, GAUTHIER-VILLARS, 1933. ISIS

Sainte-Claire Deville, H. Aluminum (its manufacture, properties, and uses). Translated from the French by ROBERT J. ANDERSON. 204 p., 13 ills. Cleveland, Ohio, Sherwood Press, 193 - (no date given). ISIS

Zehnder, L. Mes souvenirs de W. C. RÖNTGEN. *Annales Guébhard-Séverine* 9, 351-64, 4 fig., 1933. ISIS

"Pour l'envoi gratuit de cette brochure s'adresser à l'Institut Guébhard-Séverine 4, rue du Seyon, Neuchâtel (Suisse)."

C. — *Natural sciences*

Ayres, Clarence. HUXLEY. 254 p., frontispiece. New York, NORTON, 1932. ISIS

Reviewed by C. A. K., *Isis* 20, 298-300, 1933.

Cannon, Walter B. The first American laboratory of physiology. *Science* 78, 365, 1933. ISIS

1871, HENRY P. BOWDITCH, Harvard Medical School.

Osborn, Henry Fairfield; Warren, Helen Ann. COPE: master naturalist. The life and letters of EDWARD DRINKER COPE. With a bibliography of his writings classified by subject. A study of the pioneer and foundation periods of vertebrate palaeontology in America. XVI+740 p., 30 fig., maps. Princeton University Press, 1931. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 291-93, 1933.

Peterson, Houston. HUXLEY, prophet of science. XIV+338 p., 4 pl. London, LONGMANS, GREEN, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 297-98, 1933.

Spector, Banjamin. Down House, DARWIN's home. Intimate glimpses of the scientific shrine, now restored and open to the public, where CHARLES ROBERT DARWIN wrote the Origin of the Species. *Natural History* 34, 67-73, illus., 1934. ISIS

Sternberg, Charles H. The life of a fossil hunter. With an introduction by HENRY FAIRFIELD OSBORN. XIV+286 p., 46 ills., port. San Diego, JENSEN Printing Co., 1931 ($1.75). ISIS

This is the second printing of this work first issued in 1909. It contains the first-hand story of the field experiences of one of the pioneer explorers of the great fossil beds from which the remarkable series of fossil vertebrates of North America have been taken. The beds explored were the Dakota group of the Cretaceous, the Bad Lands of the Upper Cretaceous, the Kansas Chalk, the Loup Fork beds of Kansas, the Fossil Lake and John Day regions of Oregon, and the Permian and Red Beds of Texas. The collections were made for E. D. COPE (later acquired by the American Museum at New York), for ALEXANDER AGASSIZ of the Museum of Comparative Zoology at Harvard University, and for Dr. VON ZITTEL of the Palaeontological Museum of Munich. C. A. K.

Stillman, Clara G. SAMUEL BUTLER, a mid-Victorian modern. XI+319 p., 6 pl. New York, Viking Press, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 294-96, 1933.

Wassermann, Jakob. H. M. STANLEY, explorer. Translated by EDEN and CEDAR PAUL. VIII+272 p. London, CASSELL, 1932. ISIS

Reviewed by Sir MATTHEW NATHAN in *Geographical Journal*, 81, 363-66, 1933. For American edition of the same work (1933) see *Isis* 20, 568. C. W. A.

D. — *Medical sciences*

Baruch, Simon (1840-1921). Obituary by SOLOMON R. KAGAN, *Medical life* 40, 445-48, 1933. ISIS

Goldberger, Joseph (1874-1929). Obituary by SOLOMON R. KAGAN. *Medical life* 40, 434-45, 1933. ISIS

Legiardi-Laura, Cesare. CESARE LOMBROSO: the man and his work. *Medical life* 40, 354-90, 1933. ISIS

Neveu, Raymond. Le médecin principal LUDGER LALLEMAND (1802-1862). Médecin en chef du corps expéditionnaire du Mexique. *Bulletin de la société française d'histoire de la médecine* 27, 283-91, 1933. ISIS

E. — *Alia*

Drabowitch, W. La bio-psychologie de R. AVENARIUS et le problème de " l'homme total." *R. philos.* 115, 402-48, 1933. ISIS

Gaultier, Jules de. Métamorphose de la conscience morale chez NIETZSCHE. *R. philos.* 116, 5-28, 1933. ISIS

XXth Century

B. — *Physical sciences and technology*

Feldhaus, F. M. Luftfahrtmuseum der Stadt Berlin. *Isis* 20, 446, 1934. ISIS

Frost, Edwin Brant. An astronomer's life. XI+300 p., 8 pl. Boston, HOUGHTON MIFFLIN, 1933. ISIS

Reviewed in *Nature* 132, 950, 1933.

Haldane, J. B. S. Quantum mechanics as a basis for philosophy. *Philosophy of science* 1, 78-98, 1934. ISIS

Malisoff, William Marias. An examination of the quantum theories, I. *Philosophy of science* 1, 71-77, 1934. ISIS

Newell, Lyman Churchill (1867-1933). Chemist, historian of chemistry. Obituaries in *Bostonia*, The Boston University Alumni Magazine 7, 3-9, 1934. ISIS

Paul, J. Harland. The last cruise of the Carnegie. With a foreword by JOHN A. FLEMING. XVII+331 p., 198 ills. Baltimore, WILLIAMS & WILKINS, 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 300-02, 1933.

Willstätter, Richard. A chemist's retrospects and perspectives. *Science* 78, 271-74, 1933. ISIS

C. — *Natural sciences*

Babcock, E. B. JOHN BELLING (1866-1933). *Journal of Heredity* 24, 296-300, August 1933. ISIS

Caullery, Maurice. Impressions de voyage aux Etats-Unis (1933). *Bulletin de la Société Zoologique de France*, vol. 58, 181-96, port., 1933. ISIS

L'auteur a été surtout impressionné par les travaux de génétique des biologues américains, et ce discours prononcé en juin 1933 à l'assemblée générale de la Société zoologique de France est indirectement un plaidoyer pour les études de génétique qui ont été trop négligées en France. Excellent portrait. G. S.

Chapman, Frank M. Autobiography of a bird-lover. XIII+420 p.,

4 plates by LOUIS AGASSIZ FUERTES, 81 ills. New York, APPLETON, 1933 ($ 3.75). ISIS

This autobiography contains accounts of the author's well-known ornithological investigations in the United States, especially in Florida and Texas, in Cuba, Trinidad, Yucatan and Vera Cruz in Mexico, and in Colombia, Ecuador, Peru, Chile, Argentina, and Brazil. It is replete with notes on the American Ornithologists' Union, the Audubon Society, the organization of Federal agencies for bird conservation, the American Museum of Natural History, and on American and foreign ornithologists and their work. The history thus presented is of exceptional value because of its authenticity and the author's long acquaintence with the leaders in all of these enterprises. There are abundant illustrations and a partial list of the author's publications.

Reviewed by THOMAS BARBOUR, *Natural History* 34, 101, 1934.

C. A. K.

Stephenson, John (1871-1933). Obituary by GEORGE SARTON. *Isis* 20, 449, 1934. ISIS

Vacchelli, Nicola (1870-1932). Obituary notice by FILIPPO DE FILIPPI. *Geographical Journal* 81, 92-93, 1933. ISIS

Director of the Istituto Geografico Militare at Florence, 1919-1932.

C. W. A.

E. — *Alia*

(Franke, Otto). Festschrift für OTTO FRANKE zum 70. Geburtstage. 84 p., 8 pl. (*Sinica* 8). Frankfurt a.M. 1933. Tl. II-III. (*Asia Major* 9). Leipzig, 1933. ISIS

Hopkins, Sir **Frederick Gowland.** A survey of progressive science. *Nature* 132, 878-80, 1933. ISIS

From the presidential address to the Royal Society, delivered on November 30.

(Winternitz, Moriz). Festschrift MORIZ WINTERNITZ, 1863-1933. Hrsg. von .O STEIN und W. GAMPERT. VII+357 p., 1 port. Leipzig, HARRASSOWITZ, 1933. ISIS

PART II

HISTORICAL CLASSIFICATION

I. — ANTIQUITY

1. — ANTIQUITY *(generalities)*

Baumann, E. D. De diabete antiquo. *Janus* 37, 257-70, 1933. ISIS

Baumann, E. D. Ueber die Erkrankungen der Nieren und Harnblase im klassischen Altertum. *Janus* 37, 33-47, 1933. ISIS

Bortolotti, Ettore. Sul teorema di PITAGORA nelle civiltà preelleniche, e sulle unità frazionarie. *Period. matem.*, 13, 150-51, 1933. ISIS

Breasted, James Henry. The Oriental Institute. XXIII+455 p., 2 pl. 209 fig., map. (The University of Chicago survey, 12). Chicago, University Press, 1933. ISIS

This book, excellently illustrated (209 fig., and map), is far more than a guide to the Oriental Institute and its many ramifications. It might be considered an introduction to the study of Near Eastern archaeology, and I would not be surprised if it induced many Chicagoans to go and witness the excavations and other activities of their Oriental Institute and to take a deeper interest in them. The Oriental Institute is one of the very best things in Chicago to-day, and it has spread the good fame of Chicago in many countries. It was my privilege to visit Chicago House in Luxor a few years ago, and I admired its organization very much. The present volume is divided as follows : Part 1. The background and development of the Oriental Institute. 1. The task of the Orientalist and its place in science and history; 2. The background of the Oriental Institute; 3. The expansion of the Oriental Institute : the field expeditions; 4. The expansion of the Oriental Institute : the American headquarters. Part II. The field expeditions : Egypt. 5. The prehistoric survey; 6. The Sakkarah (Memphis) expedition; 7. The coffin texts; 8. The architectural survey; 9. The epigraphic expedition; 10. Egyptian painting and the Abydos expedition. Part III. The field expeditions : Western Asia. 11. The Megiddo (Armageddon) expedition; 12. The Anatolian-Hittite expedition; 13. The Syrian-Hittite expedition; 14. The Persian expedition; 15. The Iraq expedition : Babylonian section ; 16. The Iraq expedition : Assyrian section. Part IV. Activities of the home staff : research and publication. 17. The Assyrian dictionary; 18. Correlation projects and miscellaneous researches; 19. Publication.

The organization of the Royal Institute is a credit to Prof. BREASTED and his generous supporter, Mr. JOHN D. ROCKEFELLER jr. When will such magnificent opportunities be extended to the history of science?

G. S.

Burn, Andrew Robert. Minoans, Philistines and Greeks, B.C. 1400-900. XV+273 p., 16 pl. (The History of Civilization series). London, KEGAN PAUL, 1930. ISIS

Burton, Harry E. The discovery of the ancient world. 130 p. Cambridge, Harvard University Press, 1932. ISIS

Reviewed by WALTER WOODBURN HYDE, *American Historical Review* 38, 581, 1933; by WALTER WOODBURN HYDE, *Geographical Review* 23, 524-25, 1933; and by G. R. CRONE, *Geographical Journal* 81, 277-78, 1933.

Classen, Walther. Eintritt des Christentums in die Welt. Der Sieg des Christentums auf dem Hintergrunde der untergehenden antiken Kultur. VII+433 p., 1 map. Gotha, KLOTZ, 1930. ISIS

Reviewed by GERHARD KITTEL, *OLZ* 35, 327, 1932.

Darmstaedter, Ernst. Ptisana. Ein Beitrag zur Kenntnis der antiken Diaetetik. KARL SUDHOFF zum 80. Geburtstage. *Archeion* 15, 181-120, 1933. ISIS

Dobson, J. F. Ancient education and its meaning to us. 205 p. (Our Debt to Greece and Rome). New York, LONGMANS, GREEN, 1932. ISIS

Drachmann, Aage Gerhardt. Ancient oil mills and presses. 181 p., ills., facs. (Archaeologisk-Kunsthistoriske Meddelelser, vol. 1, part 1. D. Kgl. Danske Videnskabernes Selskab.) Copenhagen, LEVIN & MUNKSGAARD, 1932 (in English). ISIS

Reviewed by E. J. KENNY, *Antiquity* 7, 249-50, 1933.

Edelstein, Ludwig. Die Geschichte der Sektion in der Antike. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.*, 3, H. 2, 50-106, 1932.

"Dass die alexandrinischen Ärzte sezierten und vivisezierten, berichten verschiedene Zeugnisse. Aus früherer Zeit fehlen Angaben über Sektionen oder Vivisektionen an Menschen. Später, im ersten Jahrhundert der römischen Herrschaft, werden Sektionen noch für selbstverständlich gehalten; in der Kaiserzeit heisst es schon, sie seien unmöglich. Vivisektionen werden wohl überhaupt nicht mehr gemacht. Nach den Daten der Überlieferung beginnt also die Sektion von Menschen zugleich mit der Vivisektion in Alexandria und hört im ersten Jahrhundert n. Chr. auf."

Enriques, Federigo; Santillana, G. de. Storia del pensiero scientifico Vol. 1. Il mondo antico. 682 p., 120 ill. Milan, TREVES-TRECCANI-TUMMINELLI, 1932. ISIS

Reviewed by ALDO MIELI, *Archeion* 15, 257-61, 1933.

Hilzheimer, Max. Die ältesten Beziehungen zwischen Asien und

Afrika nachgewiesen an den Haustieren. *Africa*, 3, 472-83, London, 1930. ISIS

Hilzheimer, Max. Austausch an Haustieren zwischen Asien und Afrika vor dem 2 Jahrtausend v. Chr. *Z. Völkerpsych. u. Soziol.*, 6, 415-27, 1930. ISIS

Jalabert, Louis; Mouterde, René. Inscriptions grecques et latines de la Syrie. Tome 1 : Commagène et Cyrrhestique. No. 1-256. III+135 p. (Haut-Commissariat de la République française en Syrie et au Liban. Bibliothèque archéologique et historique, tome 12). Paris, GEUTHNER, 1929. ISIS

Reviewed by E. BICKERMANN, *OLZ*, 33, 747-48, 1930.

Janssens, Em. La zoologie pré-aristotélicienne. *Revue de l'Université de Bruxelles* 38, 371-76, 1933. ISIS

Kahlo, Gerhard. Die Kenntnis der Erde im Altertum. 32 p. (Tusculum-Schriften, 19). München, HEIMERAN, 1934. ISIS

Karst, Joseph. Origines Mediterraneae. Die vorgeschichtlichen Mittelmeervölker nach Ursprung, Schichtung und Verwandtschaft. Ethnologisch-linguistische Forschungen über Euskaldunak (Urbasken), Alarodier und Protophrygen, Pyrenaeo-Kaukasier und Atlanto-Ligurer, West- und Ostiberer, Liguro-Leleger, Etrusker und Pelasger, Tyrrhener, Lyder und Hetiter. Mit Exkursen über Atlantis, die süd- mittel-, ostasiatische und die amerikanische Völkerwelt. XXXVI+725 p. (Schriften der Elsass-Lothringischen wissenschaftl. Gesellsch. zu Strassburg. Reihe C. Geschichte u. Literatur, Bd. 3). Heidelberg, WINTER, 1931. ISIS

Reviewed by O. W., *Journal of the Royal Asiatic Society*, 933, 1931; by FERDINAND BORK, *OLZ* 36, 150-51, 1933.

Kenyon, Sir Frederic George. Books and readers in ancient Greece and Rome. VI+136 p., pl., ills. Oxford, Clarendon Press, 1932. ISIS

Lamer, Hans. Wörterbuch der Antike mit Berücksichtigung ihres Fortwirkens. In Verbindung mit E. BUX und W. SCHÖNE. XII+784 p. Leipzig, KRÖNER, 1933. ISIS

Lapeyre, G. G. Carthage. Un demi siècle de travaux archéologiques. L'œuvre du R. P. DELATTRE. 2 vols. vol. 1 : Carthage Punique, 150 p., 48 pl. ; vol. 2, Carthage Romaine et chrétienne, 150 p., 48 pl. Paris, GEUTHNER, 1933. ISIS

Luria, S. Studien zur Geschichte der antiken Traumdeutung. 60 p. Leningrad, Académie des Sciences de l'URSS, 1928. ISIS

Pendlebury, John Devitt Stringfellow. A handbook to the palace of Minos at Knossos with its dependencies. With a foreword by Sir ARTHUR EVANS. 63 p., 14 pl., 8 plans. London, MACMILLAN, 1933. ISIS

Pfaffenberg, R. Beitrag zur Geschichte der Psychotherapie bis zum Ausgang der Antike (Diss. Med. Fakult.). 40 p. Freiburg i. Br., 1930. ISIS

Przyluski, J. L'influence iranienne en Grèce et dans l'Inde. *Revue de l'Université de Bruxelles* 37, 283-94, 1931-32. ISIS

Important article, dans lequel l'auteur, par des exemples empruntés à la théorie des éléments et à l'arithmologie, montre le rôle de l'Empire perse dans la diffusion des idées. "Plus on réfléchit, plus on se persuade que la formation de l'Empire achéménide a donné une nouvelle direction à l'humanité." J. P.

Rehm, A.; Vogel, K. Einleitung in die Altertumswissenschaft. Unter Mitwirkung von J. BELOCH, hrsg. von ALFRED GERCKE u. EDUARD NORDEN. Bd. 2, 4. Aufl. H. 5 (Exakte Wissenschaften). 78 p. Leipzig, TEUBNER, 1933. ISIS

Reviewed by JOHANNES MEWALDT, *DLZ* 4, 2345-46, 1933.

Rose, John Holland. The Mediterranean in the ancient world. XI+184 p. Cambridge, University Press, 1933. ISIS

Rostovtsev, Mikhail I. Skythien und der Bosporus. Bd. I: Kritische Übersicht der schriftlichen und archäologischen Quellen. Allein berechtigte Übers. a.d. Russischen neu bearb. f. Deutschland und mit neuem Kartenmaterial versehen. XI+651 p. Berlin, SCHOETZ, 1931. ISIS

Reviewed by E. BICKERMANN, *OLZ* 36, 495-97, 1933.

Saxl, Fritz. Mithras. Typengeschichtliche Untersuchungen. XI+125 p., 43 pl. Berlin, KELLER, 1931. ISIS

Reviewed by MARTIN P. NILSSON, *DLZ* 4, 250-54, 1933.

Schachermeyr, Fritz. Etruskische Frühgeschichte. XVII+317 p., 6 ills. Berlin, DE GRUYTER, 1929. ISIS

Reviewed by ALBRECHT GÖTZE, *DLZ* 1, 1332-34, 1930.

Schütte, Gudmund. Our forefathers. The Gothonic nations. A

manual of the ethnography of the Gothic, German, Dutch, Anglo-Saxon, Frisian and Scandinavian peoples. Vol. 2 : XVI+482 p., 20 pl. Cambridge, University Press, 1933. ISIS

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2. — EGYPT

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Thureau-Dangin, F. La tablette astronomique de Nippur. *Revue d'assyriologie* 28, 85-88, 1931. ISIS

A propos du texte énigmatique que HOMMEL a fait connaître en 1908; d'après HOMMEL il remonterait à la fin du III^e^ millénaire mais cela n'est guère controlable. D'après l'auteur, ce texte est beaucoup moins ancien, mais c'est une copie ou un extrait d'une tablette qui remonterait peut être au temps de la première dynastie babylonienne. " Quoiqu'il en soit, il est certain que ce texte se rattache à tout l'ensemble de spéculations, qui caractérise le stade ' préscientifique ' de l'astronomie babylonienne. Voici, résumé en quelques mots, quel paraît être le système de mesures usité par cette ancienne astronomie : Ainsi qu'il résulte du texte que j'ai publié *Rev. d'Assyr.*, X, pp. 215 ss., les mesures employées pour évaluer les distances entre étoiles fixes sont des mesures de temps : le *bēru* 1/12 du jour et le *geš* 1/30 du *bēru*. Les étoiles sont réparties en trois groupes, celui d'Anu, celui d'Enlil et celui d'Ea, selon qu'elles se rattachent à l'équateur ou à l'un des tropiques. Dans chaque groupe elles sont censées suivre le même ' chemin ' : ce chemin est l'équateur pour les étoiles d'Anu, le tropique du Cancer pour les étoiles d'Enlil, le tropique du Capricorne pour celles d'Ea. Les distances entre étoiles du même groupe sont données par les différences en temps de leurs culminations respectives. Entre l'équateur et les tropiques la relation est, selon les Babyloniens, comme de 10 à 9 : il s'ensuit que, dans un espace de temps donné, les étoiles d'Enlil et d'Ea ne parcourent que les 9/10 de la longueur du chemin parcouru par les étoiles d'Anu durant le même temps. Pour déterminer la position de la lune et des planètes par rapport aux étoiles fixes, il est fait usage de petites mesures angulaires, le ' doigt ' qui est le 1/6 du diamètre solaire et la ' coudée ' qui représente cinq diamètres. En mesurant la durée du lever du soleil à l'une des deux époques de l'année où cet astre coupe l'équateur, les astronomes babyloniens trouvent environ 1/2 degré-temps, et ils en concluent que le diamètre solaire est contenu 720 fois dans l'équateur et, en vertu de la relation précitée, 648 fois dans chacun des deux tropiques. Le système se complète par l'établissement d'une relation entre les mesures angulaires et les mesures de longueur. Le diamètre solaire est supposé correspondre à 1.000, l'équateur a 720.000

et chacun des tropiques à 648.000 bēru itinéraires. Notre texte montre enfin que les anciens astronomes babyloniens cherchèrent en outre à mesurer l'éloignement respectif des différents astres par rapport à la terre, en se servant d'une unité de longueur égale à 32.000 coudées. Il est à observer que, puisqu'ils considéraient les étoiles fixes elles-mêmes comme inégalement éloignées de la terre, il était peu logique de conserver, dans chacun des trois groupes d'étoiles, un rapport constant entre les temps et les longueurs de chemin parcouru. Mais c'est une conséquence qu'ils paraissent n'avoir pas aperçue ou avoir délibérément écartée. Quel que fût son éloignement présumé, toute étoile était toujours censée suivre celui des trois chemins célestes auquel elle était rattachée par sa position dans le ciel. Tel était l'ensemble de mesures dont usait l'astronomie babylonienne, avant que la division tardive de l'écliptique, suivie de l'emploi des coordonnées, inaugurât sa phase proprement scientifique."

Waschow, Heinz. Angewandte Mathematik im alten Babylonien (um 2000 v. Chr.). *Studien zu den Texten* IX, 8-15. *Arch. Orientforsch.* 8, 127-31, 1932. ISIS

Weissbach, Franz Heinrich. Die Senkereh-Tafel. *Z. D. Morg. Ges.* 69, 305-20, 1915. ISIS

Reviewed by H. WIELEITNER, *Mitt. z. Gesch. d. Med.* 30, 12, 1931.

Woolley, Charles Leonard. Vor 5000 Jahren. Die Ausgrabungen von Ur und die Geschichte der Sumerer (autorisierte Übersetzung aus dem Englischen von HERIBERT HASSLER). Mit einem Geleitwort von ECKHARD UNGER. 4. Aufl. 120 p., 17 pl., 10 fig. Stuttgart, FRANCKH, 1930. ISIS

Reviewed by ALBERT SCHOTT, *OLZ* 34, 36-40, 1931.

4. — GREECE

Bonner, Campbell. The numerical value of a magical formula. *Journal of Egyptian archaeology* 16, 6-9, 1 pl., 4 fig., 1930. ISIS

Apropos of a gnostic stone the total numerical value of which is 9999 and other formulas leading to the same number. G. S.

Deichgräber, Karl. *ΠΡΟΦΑΣΙΣ.* Eine terminologische Studie. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 1-17, 1933. ISIS

Delatte, A. La catoptromancie grecque et ses dérivés. 221 p., 13 pl. (Bibliothèque de la Faculté de philosophie et lettres de l'Université de Liége, facs. 48). Liége, VAILLANT-CARMANNE, 1932. ISIS

Reviewed by HARRIET P. LATTIN, *Isis* 20, 478-80, 1934.

Edelstein, Ludwig. Empirie und Skepsis in der Lehre der griechischen. Empirikerschule. *Quellen und Studien zur Gesch. d. Naturw .u. d. Med.* 3, H. 4, 45-53, 1933. ISIS

Festugiere, A. J. (Ord. Predic.). L'idéal religieux des Grecs et l'Evangile. 328 p. Paris, LECOFFRE, 1932. ISIS

The author is a classical scholar, having studied at Rome and Athens. He describes graphically the theological import of the various Greek schools of philosophy (excluding neo-Platonism). These are set down at a rather low value, and the author's occasional failure to use terms as a trained philosopher would do, detracts from an otherwise highly creditable study, that will command the attention of classicists and of Christian thinkers. The volume has already received the " Prix Thérouanne " of the French Academy and the " Prix Théodore Reinach " of the French Association of Greek Studies. H. B.

Hansen, Hazel D. Early civilization in Thessaly. 203 p., 85 ills., 4 maps. (Johns Hopkins University Studies in Archaeology, no. 15). Baltimore, 1933. IISS

Reviewed by STANLEY CASSON, *Antiquity* 7, 363, 1933.

Riedel, Ernest. The number " fifty." *The Classical Journal* 25, 696-98, 1929-30. ISIS

" The purpose of this note is to call attention to the frequency of the number " fifty " in the Greek tradition." J. P.

Riemschneider, Wilhelm. Ein Krankenbett auf der antiken Bühne. *Janus* 37, 275-80, 1933. ISIS

II. — MIDDLE AGES

6. — MIDDLE AGES *(generalities)*

Diepgen, Paul. Reste antiker Gynäkologie im frühen Mittelalter. *Quellen und Studien zur Gesch. der Naturw. u. d. Med.* 3, H. 4, 18-34, 1933. ISIS

" Den äusseren Anlass zu dieser Veröffentlichung gibt neben dem Wunsche, wenigstens mit einem bescheidenen Beitrag an dem WELLMANN gewidmeten Bande beteiligt zu sein, der Umstand, dass aus meinem Schülerkreis zwei Dissertationen hervorgegangen sind, die bisher unbekannte frühmittelalterliche Texte gynäkologischen Inhalts bringen. Die eine von BRÜTSCH erschien schon 1922, die andere von EGERT wird in Bälde gedruckt sein."... " Es wäre interessant, einmal festzustellen, was alles aus der Antike in dieser Mönchsmedizin fehlt. So viel, wie man bisher angenommen hat, war es nach diesen Untersuchungen nicht. Auch im frühen Mittelalter hat ein

beachtliches gynäkologisches Wissen bestanden. Wir müssen unser Urteil nach dieser Richtung revidieren."

Hoffmann, Gerda. Beiträge zur Lehre von der durch Zauber verursachten Krankheit und ihrer Behandlung in der Medizin des Mittelalters. *Janus* 37, 211-17, 1933. ISIS

Irsay, Stephen d'. Les sciences de la nature et les universités médiévales. *Archeion* 15, 216-31, 1933. ISIS

Jones, C. W. POLEMIUS SILVIUS, BEDE, and the names of the months. *Speculum* 9, 50-56, 1934. ISIS

"Although students in the West during the early Middle Ages knew very little about the language and customs of eastern races, the names of the months according to the Hebrews, Egyptians (Alexandrians), Athenians, Macedonians, and other eastern peoples appear at intervals in western literature. Professor MOUNTFORD called attention to one source for these lists. This note will discuss another, and more popular, source for the names of the months according to the Hebrews, Egyptians, and Greeks (Macedonians)."

Kind, F. Ernst. Zum Fragmentum Donaueschingense und zum Reichenauer Antidotarium. *Archiv für Geschichte der Medizin* 26, 344, 1933. ISIS

McKeon, Richard. Utility and philosophy in the Middle Ages. *Speculum* 8, 431-36, 1933. ISIS

Nelson, Axel. Om Uppsala Universitet under Medeltiden. Några anteckningar. Symbola litteraria, Hyllningsskrift till Uppsala Universitet, 1-46, 2 pl., 3 fig. Uppsala, ALMQVIST & WIKSELL, 1927. ISIS

Notes on the University of Uppsala in the Middle Ages. G. S.

Thompson, Daniel V., jr. Artificial vermilion in the Middle Ages. *Technical studies*, 2, 62-70, 1933. ISIS

"The ultimate classification of medieval painting materials requires two types of research: the micro-analytical investigation of objects of known date and provenance, and the codification of the written traditions of medieval technology. This codification must involve some understanding of the sources of technical knowledge during the Middle Ages, and of the manner of its diffusion. I believe that study of the history of artificial vermilion will advance this understanding, and in that belief I offer here a summary account of some medieval references to the manufacture of that pigment."

Vorwahl, H. Die Sexualität im Hoch-Mittelalter. *Janus* 37, 293-99, 1933. ISIS

III. — ORIENTAL SCIENCE AND CIVILIZATION

8. — WESTERN ASIA

Contenau, G. Manuel d'archéologie orientale depuis les origines jusqu'à l'époque d'ALEXANDRE. 3 vols. 1686 p., 974 fig., 4 maps. Paris, PICARD, 1927-31. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 474-78, 1934.

Friederichs, H. F. Zur Kenntnis der frühgeschichtlichen Tierwelt Südwestasiens unter bes. Berücks. d. Neuen Funde von Mohenjo-Daro, Ur, Tell Halaf u. Maikop. 45 p., 8 pl. (*Der alte Orient*, 33). Leipzig, HARRASSOWITZ, 1933. ISIS

CENTRAL ASIA

Henning, W. Zum zentralasiatischen Manichäismus. *OLZ* 37, 1-11, 1934. ISIS

Apropos of ERNST WALDSCHMIDT and WOLFGANG LENTZ (Berlin 1933).

Jackson, Abraham Valentine Williams. Researches in Manichaeism: with special reference to the Turfan fragments. XXXVIII+394 p., 1 fig. New York, Columbia University Press, 1932. ISIS

Reviewed by H. W. BAILEY, *Journal of the Royal Asiatic Society*, 145-46, 1934.

Thomas, F. W. Tibetan documents concerning Chinese Turkestan. VII : Government and social conditions. *Journal of the Royal Asiatic Society*, 85-112, 1934. ISIS

Includes information on agriculture and crops, travel and animals, medicine, law, writing and letters, etc.

EASTERN ASIA

(Including works relative to the whole of Buddhist Asia, or to India, Central and Eastern Asia combined)

Bu-ston. History of Buddhism (Chos-hbyung). I. part : The jewelry of scripture. II. part : The history of Buddhism in India and Tibet. Transl. from Tibetan by E. OBERMILLER . With an introduction by TH. STCHERBATSKY. 187-231 p. (Materialien zur Kunde des Buddhismus, H. 18 u. 19). Leipzig, HARRASSOWITZ, 1931/2. ISIS

Reviewed by JOHANNES SCHUBERT, *OLZ* 37, 48-51, 1934; by ST. SCHAYER, *DLZ* 4, 1977-80, 1933.

Thomas, Edward J. The history of Buddhist thought. XVI+314 p., 4 ills. London, KEGAN PAUL, 1933. ISIS

Tripitaka in Chinese (Taisho Issai-Kyo). New edition by J. TAKAKUSU and K. WATANABE. Classified index. Vol. 1. Tokyo, 1933. ISIS

Tripitaka. Ying-yin sung chi-sha ts'ang-ching. (Facsimile reproduction of a Sung edition of the Buddhist Tripitaka), 592 vols. Shanghai, 1933-35. ISIS

Announcement in OTTO HARRASSOWITZ' *Litterae orientales*, H. 57, p. 43, 1934. "Bei dieser Ausgabe, die nach Photographien von einer der wenigen Sung-Ausgaben der Tripitaka hergestellt wird, handelt es sich um die sogenannte Chi Sha-Ausgabe, genannt nach einem Ort Chi Sha, jetzt Vorort von Soochow, wo der Druck zwischen 1237 und 1240 begonnen und gegen 1310 beendet wurde. CHU CHING-LAN entdeckte im Jahre 1929 ein nahezu vollständiges Exemplar dieser Ausgabe in zwei Tempeln zu Sian, Provinz Shensi. Die fehlenden 173 Bändchen (von 6529 des Gesamtwerkes) werden bei der Reproduktion durch Teile einer der anderen Sung-Ausgaben, von denen übrigens keine vollständig erhalten ist, ersetzt. Es gelangen nur 250 Exemplare der Faksimile-Ausgabe in den Handel. Die Veröffentlichung soll bis Mitte 1935 beendet sein."

9. — INDIA

Datta, Bibhutibhusan. The science of the Śulba. A study in the early Hindu geometry (Readership lectures for the year 1931). XV+239+8 p., 79 fig. Calcutta, University Press, 1932. ISIS

A review of this book is being prepared for *Isis* 22, 272-7.

Filliozat, J. Les Gajaçâstra et les auteurs grecs. A propos de deux livres récents. *Journal asiatique* 222, 163-75, 1933. ISIS

Apropos des ouvrages de HEINRICH ZIMMER (Munich 1929) et F. EDGERTON (1931), voir *Isis* 14, 525; 19, 425. G. S.

Law, Bimala Churn. Geography of early Buddhism. XXII+88 p. London, KEGAN PAUL, 1932. ISIS

Reviewed by C. E. A. W. OLDHAM, *Geographical Journal* 81, 551, 1933. "A fairly complete compilation of such geographical information as exists in the Pali Buddhist texts, supplying carefully collated references to the texts in which the names occur." C. W. A.

Mackay, Dorothy. Mohenjo-daro and the ancient civilization of the

Indus Valley. *Annual report of the Smithsonian Institution*, 429-44, 4 pl., 1932. ISIS

Müller, Reinhold F. G. Über den Bau des Körpers nach der alten indischen Medizin. *Mitt. z. Gesch. d. Med.* 32, 300, 1933. ISIS

Müller, Reinhold F. G. Vom Körperaufbau in der altindischen Medizin. *Archiv für Geschichte der Medizin* 26, 310-17, 1933. ISIS

Müller, Reinhold F. G. Zur Lehre vom Stoffwechsel in der altindischen Medizin. *Fortschritte der Medizin* 51, 1009-11, 1933. ISIS

Rahmat Ali. Contribution à l'étude du conflit Hindou-musulman. VIII+144 p. Paris, GEUTHNER, 1933 (30 frs.). ISIS

" Le monde colonial britannique attribue le problème au fanatisme religieux des masses indiennes; le nationalisme indien le considère comme une création de l'impérialisme britannique. L'auteur tient à démontrer qu'en dépit des apparences religieuses, le conflit hindou-musulman est le reflet des rapports économiques établis dans la campagne et les villes entre les différentes couches sociales. Mais il ne sous-estime pas l'importance des facteurs de nature politique."

Vogel, J. Ph. Annual bibliography of Indian archaeology for the year 1931. Published with the aid of the Government of Netherlands India and with the support of the Imperial Government of India. X+210 p., 12 pl., 4 ills. Kern Institute, Leyden, 1933. ISIS

This bibliography of which the earlier issues (1926 ff.) were duly announced in *Isis*, needs no further recommendation. Its excellence is now internationally recognized; it suffices to say that a new volume is available. G. S.

10. — CHINA

Chang, T'ien-Tsê. Sino-Portuguese trade from 1514 to 1644. A synthesis of Portuguese and Chinese sources. VIII+157 p. Leyden, BRILL, 1934. ISIS

The author of this doctor's thesis (Leiden 1933) is already known to our readers by his analysis of the first volume of CHIA MING's Elements of dietetics (*Isis* 20, 324-34, 1934). We cannot discuss the present work as elaborately as we would wish, as economic history is outside our field. It will suffice to indicate the contents : 1. An historical sketch of China's maritime trade down to 1513; 2. The early Sino-Portuguese commercial relations; 3. The expulsion of foreigners from China and the prohibition of foreign trade; 4. Trade or no trade; 5. The rise of Macao; 6. The arrival of other Europeans in the Far East and the position of the Portuguese; 7. Macao in days of tribulation and the decline and stagnation of Sino-Portuguese trade. G. S.

Fo-tsang tzu-mu yin-tê. (Combined indices to the authors and titles

of books and chapters in four collections of Buddhistic literature). 3 vols. 41+266 p.; 459 p.; 412 p. (Harvard-Yenching Institute, Sinological index series, 11). Peiping, 1933. ISIS

Pinot, Virgile. La Chine et la formation de l'esprit philosophique en France (1640-1740). 480 p. Paris, GEUTHNER, 1932. ISIS

Reviewed by CLARENCE H. HAMILTON, *Isis* 20, 482-84, 1934; by O. FRANKE, *OLZ* 36, 646-53, 1933.

Pinot, Virgile. Documents inédits relatifs à la connaissance de la Chine en France de 1685 à 1740. 130 p. Paris, GEUTHNER, 1932. ISIS

Reviewed by CLARENCE H. HAMILTON, *Isis* 20, 482-84, 1934; by O. FRANKE, *OLZ* 36, 646-53, 1933.

Wong, K. Chimin; Lien-teh, Wu. History of Chinese medicine. Being a chronicle of medical happenings in China from ancient times to the present period. XVIII+706 p., frontispiece, 92 ills., map. Tientsin, Tientsin Press (no date; general preface dated Shanghai, July 15, 1932). ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 480-82, 1934.

11. — JAPAN

Hasama, Bun-Ichi. Geschichtliche Daten über die Ersteinführung des deutschen Medizinalwesens in Japan. *Sudhoffs Archiv für Geschichte der Medizin* 26, 329-34, 1933. ISIS

Iba, Yasuaki. Fragmentary notes on astronomy in Japan. *Y. Iba Astronomical Observatory* 6, 34 p., Kobe, Japan, 1932. ISIS

Ogura, K. History of mathematical education. IV+356 p. Tokyo, Iwanami Shoten, 1932 (in Japanese). ISIS

Reviewed by S. IKEHARA, *Isis* 20, 305-07, 1933.

12. — ISRAEL

(Including works devoted to Palestine)

Fischer, Isidor. On the ethics of the Jewish physician. *Medical life* 40, 403-10, 1933. ISIS

Gandz, Solomon. Hebrew numerals. *Proceedings of American Academy for Jewish Research*, 4, 53-112, 1932-33. ISIS

Contents: I. Introduction. 1. Three phases in the development of numerical notation: " 1. Pictorial ideograms; 2. Phonograms; 3. Con-

ventional, symbolic ideograms. Thus the phonograms, numeral words, are preceded and followed by ideograms, special numeral symbols." II. Hebrew-Aramaic numerals of the primitive stage. 2. The problem. Fifteen centuries without numerals. 3. A reference to numerals in ISAIAH. 4. Hebrew numerals on the Samaritan ostraca (c. 800 B.C.). 5. The Aramaic papyri and their numerals. 6. The Aramaeans and the spread of their language. 7. Hebrew numerals on the ossuaries of the first century A.D. 8. Origin and development of the Semitic numerals. 9. Tables of the Semitic numerals. III. Alphabetic numerals. 10. Three kinds of alphabetic numerals. 11. The initial numerals. 12. Two theories on the origin of the alphabetic numerals. 13. The alphabetic ordinalia and the alphabetic order. 14. Greek and Hebrew ordinalia. 15. Alphabetic decimalia and the gematria. 16. The numerical function of the final letters. 17. Spread of the alphabetic numerals. IV. Conclusion. 18. Words, letters and numerals.

Gottheil, Richard. La Génizah du Caire et son intérêt pour l'histoire des sciences. *Archeion* 15, 232-38, 1933. ISIS

Lauterbach, Jacob Z. *Mekilta de Rabbi* ISHMAEL. A critical edition on the basis of the manuscripts and early editions with an English translation, introduction and notes. 2 vols. out of 3. LXIV+255 p.; 292 p. Philadelphia, Jewish Publication Society, 1933. ISIS

The Schiff Library of Jewish Classics—very elegant volumes similar to those of the Loeb Classical Library—is now enriched with these two volumes containing one of the oldest commentaries on *Exodus*. "Among these Tannaitic Midrashim, the one to *Exodus*, now designated by the name *Mekilta* (properly *Mekilata*) or *Mekilta de Rabbi* ISHMAEL, is one of the oldest Midrashim, although it is nowhere mentioned in the Talmud by its present name. It represents a tannaitic exposition of a large part of the book of *Exodus*, and deals with practically all the laws contained in that book as well as with some of its most important narrative portions. The contents of this Midrash, accordingly consist of both Halakah and Haggadah. In fact, they are more haggadic than halakic, even though the book is not infrequently referred to as an halakic Midrash. The biblical book of *Exodus* contains by far more narrative than law. Hence an exposition of it, such as our *Mekilta* is, naturally would be more haggadic than halakic. More specifically, only about two-fifths of its total contents is halakic in character, while about three-fifths is of an haggadic nature."

The Hebrew text has been established on the basis of seven MSS., three ancient editions (Constantinople, 1515, Venice 1545, Leghorn 1801, and compendia or other works containing fragments. I hope than an index will be included in the third volume. This is certainly the best method of giving a new currency to the Jewish classics. G. S.

Marx, Alexander. A new collection of manuscripts. A recent acquisition of the Library of the Jewish Theological Seminary. *Proceedings of American Academy for Jewish Research*, 4, 135-67, 1932-33. ISIS

Apropos of the collection of over 1100 Hebrew and Judaeo-Arabic MSS.

made by the Vienna bookdealer JACOB HALPERN and acquired by the Jewish Theological Seminary of America. " A fact which strikes one particularly is the wealth of books that come from Yemen. That distant country must have had much closer relations to other centers of Judaism around the fifteenth and sixteenth centuries than has hitherto been suspected. The works of scholars of every country are represented, many of them very rare and even unknown." Most of the MSS. are biblical, talmudic, theological, but there are a few medical and scientific ones (p. 164-6). G. S.

Morrison, Hyman. The early Jewish physicians in America. With reference to some in the nineteenth century. *Medical life* 40, 411-33, 1933. ISIS

Myerson, Abraham; Goldberg, Isaac. The German Jew: his share in modern culture. XIII+161+IX p. London, HOPKINSON, 1933. ISIS

Reviewed in *Nature* 132, 428, 1933.

Roth, Cecil. The feast of Purim and the origins of the blood accusation. *Speculum* 8, 520-26, 1933. ISIS

" I cannot help feeling that the accusation was founded in the first instance, not so much on malice as on misunderstanding: not so much on hatred as on excess of zeal. There is in history that which may perhaps explain the origins of the ghastly libel, though indeed not providing the slightest justification for it. We have, as so often, not the melodrama of a struggle between right and wrong, but a Greek tragedy of a conflict in which both sides are prompted by a sense of justice, and in which even the fundamental error of the one has at its root a genuine misunderstanding. This assuredly makes the drama far more poignant."

14. — ISLAM

Colin, Georges S. De l'origine grecque des " chiffres de Fès " et de nos "chiffres arabes," *Journal asiatique* 222, 193-215, 1933. ISIS

" A côté de la série de dix chiffres, qui est d'ailleurs la seule couramment employée, il existe encore aujourd'hui — mais, semble-t-il, exclusivement à Fès — une série particulière composée de vingt-sept signes à valeur absolue; elle est utilisée uniquement par les notaires, qui s'en servent dans les actes de règlement des successions pour noter les parts revenant à chacun des héritiers: c'est cette série de signes spéciaux qui constitue ce que l'on nomme de nos jours les ' chiffres de Fès,' ou, en arabe, *al-qalam al-fāsī* ' la graphie de Fès.' L'existence de ces chiffres ne paraît avoir été révélée aux milieux européens qu'en 1917, grâce à la publication par M. E. VIALA d'une brochure intitulée: *Le mécanisme du partage des successions en droit musulman, suivi de l'exposé des ' Signes de Fez.'* Mais, dès novembre 1901, la parution à Fès d'une édition lithographiée de l'ouvrage d'AL-'UQAILĪ intitulé *Silk farā'id al-yawāqīt* avait permis aux arabisants d'en prendre connaissance." L'auteur conclut:

" A. Les Grecs adoptent comme chiffres à valeur absolue les vingt-sept lettres de l'alphabet ' phénicien.' Cette série se maintient dans le monde hellénisé *pour la notation figurée des nombres;* elle passe dans le monde arabe et survit aujourd'hui encore à Fès.

B. Sans doute à la faveur de l'emploi fort ancien de l'abaque à colonnes, on arrive, *pour le calcul*, à se borner à l'emploi des neuf premiers signes de la série, qui prennent dès lors une valeur de position.

α. Dans le monde méditerranéen, ces neuf chiffres voient leur emploi se répandre, peut-être à la faveur des travaux des Néo-Pythagoriciens d'Alexandrie; ce sont eux qui, vraisemblablement, sont à l'origine plus ou moins immédiate des apices, des chiffres arabes du type *ghubārī*, et, par l'intermédiaire de ces derniers, de nos chiffres arabes. *β*. Ces mêmes neuf chiffres grecs, passés anciennement dans l'Inde, sont introduits dans le monde arabe, vers le IX^{e} siècle, comme outils indispensables des méthodes simplifiées de calcul inventées par les Hindous. Ces méthodes passent dans l'Occident chrétien, mais on les y applique en utilisant les chiffres dérivés du type *ghubārī*."

J'ai reproduit ces conclusions verbatim car elles sont fort suggestives et méritent d'être discutées, en tenant compte des mémoires de S. GANDZ (*Isis* 16, 393-424, 1931) et de Mrs. H. P. LATTIN (*Isis* 20, 181-94, 1933).

G. S.

Duguet, Le docteur. Le pèlerinage de la Mecque au point de vue religieux, social et sanitaire. Préface de JUSTIN GODART. XII+357 p., 8 pl. Paris, RIEDER, 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 499-503, 1934.

González Palencia, Angel. Precedentes islámicos de la leyenda de GARÍN. *Al-Andalus* 1, 335-55, 1933. ISIS

" La leyenda de BARṢIṢA en la literatura islámica : los comentaristas del Alcorán, las colecciones de cuentos y anécdotas piadosas. Difusión de la leyenda en el mundo islámico. Versiones de la leyenda, conservadas en la literatura arábigoespañola y en la aljamiada. La leyenda y los *fabliaux* franceses. Versión en el siglo XVIII por PETIS DE LACROIX, utilizada por el inglés M. G. LEWIS. La leyenda de GARÍN, según el *Libro de las grandezas y cosas memorables de España*, de PEDRO DE MEDINA. Falta de base histórica del ' mal hilado cuento de GARÍN,' segun BOFARULL. La leyenda de SANTIAGO EL ASCETA y sus derivaciones. Coincidencias entre la leyenda de BARṢIṢA y la de GARÍN."

Herber, J. Le mensonge et la feinte prophylactiques au Maroc. *Revue de l'histoire des religions* 108, 229-45, 1933. ISIS

Ivanow, W. Notes sur l' " Ummu l-kitâb " des ismaëliens de l'Asie centrale. *Revue des études islamiques*, année 1932, cahier 4, 419-78. (Reçu en oct. 1933). ISIS

" L'*Ummu l-kitâb*, livre relativement peu étendu, écrit en langue persane archaïque, est considéré comme un des ouvrages les plus sacrés de la littérature

religieuse des Ismaïlis habitant les provinces de l'Oxus supérieur." Origine de ce livre. Doctrine. Analyse. Table des noms propres de personnes et des termes techniques. G. S.

Laignel-Lavastine, M.; Milad, Ahmed ben. L'école médicale de Kairouan aux X^e^ et XI^e^ siècles. *Bulletin de la société française d'histoire de la médecine* 27, 235-42, 1933. ISIS

Mercier, Gustave. La numération libyenne. *Journal asiatique* 222, 303-22, 1933. ISIS

"La grande majorité des dialectes berbères ont, postérieurement à la conquête musulmane, incorporé à leur vocabulaire la numération arabe, mais à partir seulement du nombre trois." L'auteur s'efforce de justifier cette diffusion extraordinaire de la numération décimale dans l'Afrique du Nord. Les influences arabes ont été préparées et facilitées par des influences phéniciennes et peut-être égyptiennes. G. S.

Meyerhof, Max. Die Materia Medica des DIOSKURIDES bei den Arabern. *Quellen und Studien z. Gesch. d. Naturw. u. d. Med.* 3, H. 4, 72-84, 1933. ISIS

See note in section on I(2). G. S.

Nau, François. Les Arabes chrétiens de Mésopotamie et de Syrie du VII^e^ au VIII^e^ siècle. 135 p. (*Cahiers de la société asiatique*, première série, I). Paris, Imprimerie Nationale, 1933 (30 frs.) ISIS

Étude fort intéressante mais qui est malheureusement restée inachevée, à cause de la mort prématurée de l'auteur. Le reviseur paresseux, MAURICE BRIÈRE, s'est contenté de corriger les épreuves d'imprimerie; il ne s'est pas donné la peine d'ajouter une table de matières qui nous permit de saisir le plan de l'ouvrage, ni un index, ni une courte note biographique. Dans ces conditions on peut se demander s'il n'a pas baclé aussi vite que possible le reste de sa besogne. L'abbé FRANÇOIS NAU était un mathématicien et il enseignait l'analyse à l'Institut Catholique de Paris. Ses études sur l'astronomie syrienne et sur SEVERUS SEBOKHT avaient été fort remarquées (voir mon *Introduction*, vol. 1, 493). G. S.

Nykl, A. R. La poesia a ambos lados del Pirineao hacia el año 1100. *Al-Andalus* 1, 357-405, 1933. ISIS

Comparative study of poetry on both sides of the Pyrénées about the year 1100, concluding that Arabic-Andalusian influences can be detected in the Provençal compositions. G. S.

Ruska, Julius. Turba philosophorum: Ein Beitrag zur Geschichte der Alchemie. 388 p. (*Quell. u. Stud. z. Gesch. d. Naturw. u. d. Med.*, 1). Berlin, SPRINGER, 1931. ISIS

Reviewed by E. J. HOLMYARD, *Isis* 20, 302-05, 1933.

Sarton, George. Arabic " commercial " arithmetic. (Query no. 23). *Isis* 20, 260-62, 1933. ISIS

Sarton, George. Orientation of the miḥrāb in mosques. (Query no. 25). *Isis* 20, 262-64, 1933. ISIS

PART III

SYSTEMATIC CLASSIFICATION

I. — SCIENCE IN GENERAL

16. — HISTORY OF SCIENCE

Beard, Charles A. A century of progress. VIII+452 p. New York, HARPER, 1933 ($ 3.). ISIS

Under the editorship of CHARLES A. BEARD, fourteen authors collaborate in this volume, which takes its title from the Chicago Exposition of 1933. The editor defines progress as based on the rational method of science and technology. This method implies an open-eyed and open-minded attitude toward tasks and problems. It is universal in reach, indifferent in emotion, catholic in scope, objective in manipulations, democratic and leveling in its effects, rational and planful, and working in the unity of all things. It is also centripetal, drawing all arts, economics, and sciences, inward toward the unity of the world, in harmony with mankind's noblest dreams. WALDEMAR KAEMPFFERT writes a stimulating chapter on invention as a social manifestation in American life. He treats of the generation of energy, transportation, communication, metallurgy, metal working, illumination, and labor-saving machinery, with names of inventors, with their dates, and of many outstanding steps in the progress in these fields of discovery. FRANK O. LOWDEN reviews scientific developments and economic progress (?) in agriculture. WATSON DAVIS discusses advancement in the natural sciences, including a catalogue of some of the major contributions of American investigators in the physical and biological sciences, without, however, much perspective of relative values or analysis of significant features in this very extensive field. The scientific part of the work closes with a critical summary of American contributions to medicine by the historian of medicine, F. H. GARRISON. One views this presentation of the Century of Progress in this *scientific age* with the conviction that the authors failed to bring Hamlet upon the stage. C. A. K.

Caullery, Maurice. La science française depuis le XVII^e^ siècle. 215 p. (Collection ARMAND COLIN). Paris, COLIN, 1933 (10 fr. 50). ISIS

Comme le dit l'auteur dans son Avant-Propos " La science est, par essence, une œuvre universelle, indépendante des frontières et des nationalités. Mais

cependant, ce n'est pas une chose vaine de suivre son développement dans un pays particulier : d'abord, parce qu'on peut légitimement se proposer de savoir ce qu'un pays donné a fourni au progrès scientifique; ensuite, à un point de vue plus général, parce qu'en chaque pays, en fonction des particularités de sa civilisation, de sa culture, le progrès scientifique a une allure spéciale. Il est intéressant d'analyser ce qui y a favorisé ou entravé l'essor de la science, le rôle qu'y ont eu les institutions ou les établissements qui lui sont propres. Chaque nation a aussi sa mentalité particulière, qui influe, d'une façon indéniable, sur sa vie scientifique. La science française a ainsi des caractères très individualisés." Il est donc fort utile d'écrire un livre comme celui-ci et l'auteur l'a fait admirablement, sans chauvinisme, sans dénigrement des efforts étrangers. Je l'ai lu d'un bout à l'autre avec grand plaisir et n'y ai trouvé aucune lacune importante. A vrai dire cependant j'aurais aimé que l'auteur fit une part plus large à la philosophie des sciences : il en parle un peu à propos de DESCARTES et de COMTE mais cela ne suffit pas, et il ne nous dit rien de l'histoire des sciences, quoique COMTE lui en donnât l'occasion. En dehors de COMTE la France a donné au monde deux grands initiateurs dans ce domaine : PAUL TANNERY et PIERRE DUHEM, sans parler de plusieurs autres savants de grande distinction tels que MONTUCLA, DELAMBRE et DAREMBERG. La philosophie et l'histoire de la science en sont des parties essentielles. Il serait fort désirable que cet ouvrage fut traduit en anglais, et qu'on y ajoutât une série de portraits. G. S.

Lacroix, Alfred. Figures de savants. 2 vols. x+326 p., 356 p. Paris, GAUTHIER VILLARS, 1932. ISIS

Reviewed by HÉLÈNE METZGER, *Archeion* 15, 281-82, 1933.

Lenard, Philipp. Great men of science : a history of scientific progress. Translated from the second German edition by H. STAFFORD HATFIELD. XIX+389 p., 48 pl. London, BELL, 1933. ISIS

Reviewed by RUTHERFORD, *Nature* 132, 367-69, 1933.

(Paris). Institut d'histoire des sciences, année scolaire 1932-1933. *Isis* 20, 265, 1933. ISIS

Radner, David B. The intolerance of great men. *Annals of Medical History* 5, 561-65, 1933. ISIS

Sarton, George. Introduction to the history of science, vol. 2 : From Rabbi BEN EZRA to ROGER BACON. In two parts. XXXV+1251 p. Baltimore, WILLIAM & WILKINS, 1931. ISIS

Reviewed by HUGO BÉVENOT, *Literarische Beilage der Augsburger Postzeitung*, Nr. 44, 31. Okt. 1933; by L. C. KARPINSKI, *Speculum* 8, 538-41, 1933; by PAUL TESDORPF, *Münchener medizinische Wochenschrift*, Nr. 51, S. 2024, 1933.

Sarton, George. The teaching and study of the history of science at the University of California. *Isis* 20, 6-14, 1933. ISIS

"Having just returned from California, where I spent five delightful weeks (from Jan. 4th to February 7th, 1933), it occurred to me that a report of my experiences and impressions might be of interest to our readers. It is simpler to state my conclusion at once: No university, certainly no American university, has done as much to promote the study of the History of Science as the University of California. I think the following facts will make its leadership sufficiently clear."

Sarton, George. Lectures on the history of science in Syria and Palestine. *Isis* 20, 448, 1934. ISIS

Sarton, George. Thirty-eighth critical bibliography of the history and philosophy of science and of the history of civilization (to March 1933,—with special reference to the seventeenth and eighteenth centuries). *Isis* 20, 506-626, 1934. ISIS

"This thirty-eighth Bibliography contains about 665 items of which 251 deal with the seventeenth and eighteenth centuries. They have been kindly contributed by fourteen scholars belonging to five different countries."

Urbain, Georges; Boll, Marcel. La science, ses progrès, ses applications. 16 p. Paris, LAROUSSE, 1934 (4.75 fr. par fascicule; ou en deux volumes brochés, 230 frs.). ISIS

This is an abundantly and superbly illustrated encyclopedia of the physical sciences, to be completed in May 1934, with 2,500 engravings and numerous plates, of which 12 are in color. The opening chapter, on the prehistory and origins of science, is by ARNOLD REYMOND of Lausanne. The wealth of portraits and reproduction of illustrations from works of historical significance make this addition to LAROUSSE's quarto series of encyclopedic works of prime value to everyone interested in the history of the sciences and their applications. C. A. K.

Vetter, Q. L'histoire des sciences en Tchécoslovaquie. *Bulletin du Comité international des sciences historiques* 19, 333-52, 1933. ISIS

18. — PHILOSOPHY OF SCIENCE

Cox, Richard T. Time, space and atoms. 154 p. Baltimore, WILLIAMS & WILKINS, 1933. ISIS

Reviewed by V. F. LENZEN, *Isis* 20, 484, 1934.

Lenzen, Victor F. The nature of physical theory. A study in the theory of knowledge. XII+301 p. New York, WILEY, 1931. ISIS

Reviewed by H. T. DAVIS, *Isis* 20, 488-91, 1934; by HEINRICH SCHOLZ, *DLZ* 4, 2250-52, 1933.

Mead, George Herbert (1863-1931). The philosophy of the present. XI+199 p. Chicago, Open Court, 1932. ISIS

Reviewed by H. T. DAVIS, *Isis* 20, 307-10, 1933.

Merriam, John C. Science and the constructive life. University of Virginia Alumni News, 5 p., April 1933. ISIS

Lecture delivered as the Founder's day address, at the University of Virginia, in Cabell Hall, April 13, 1933.

Philosophy of science. Vol. 1, number 1. Published quarterly for the Philosophy of Science Association by the WILLIAMS & WILKINS Company, Baltimore, Maryland. 131 p. January 1934. ISIS

We greet with pleasure the first part of this new periodical edited by WILLIAM MARIAS MALISOFF of Philadelphia, and very beautifully got up. We wish it every success. Every number will be analyzed in *Isis*, the present one being analyzed in the 40th C.B. The subscription price is $5.00 per volume. G. S.

Rádl, Emil. Zur Philosophie des Wissenschaftsgeschichte. *Scientia*, 54, 309-15, 1933. Trad. française, ibid., 133-38. ISIS

" La psychologie des découvertes rentre dans l'histoire de la science, leur logique est dans la science... Étudier dans quels rapports de dépendance sociale se trouve la science, est une tâche importante de son histoire... Suivre cette influence sociale des savants constitue une autre tâche importante de l'histoire de la science... L'histoire de la science devrait étudier les conditions sociales du travail scientifique... Qui donc, plus que l'historien de la science, devrait se préoccuper des problèmes de la liberté en matière de recherche et d'enseignement?... Un chapitre de l'histoire de la science intéressant du point de vue psychologique est celui des mensonges scientifiques. En quoi, à dire vrai, consiste une supercherie scientifique?... L'historien de la science est lui-même un soldat de l'éternel combat pour la vérité, nullement un simple observateur;... *nolens volens*, il fait de l'agitation et prend parti; qu'il lutte donc ouvertement et prenne le bon parti de la vérité et de l'humanité ! "

Stace, W. T. The theory of knowledge and existence. XII+455 p. Oxford, University Press, 1932. ISIS

Reviewed by H. T. DAVIS, *Isis* 20, 485-88, 1934.

II. — FORMAL SCIENCES (knowledge of forms)

19. — LOGIC AND THEORY OF KNOWLEDGE

Feigl, Herbert. The logical character of the principle of induction. *Philosophy of science* 1, 20-29, 1934. ISIS

Keyser, Cassius J. The nature of the doctrinal function and its role in rational thought. *Scripta mathematica* 2, 5-26, 1933. ISIS

20. — MATHEMATICS

Archibald, Ralph G. Quadratic Diophantine equations. *Scripta mathematica* 2, 27-33, 1933. ISIS

Bell, E. T. Finite or infinite? *Philosophy of science* 1, 30-49, 1934. ISIS

Bentley, Arthur F. Linguistic analysis of mathematics. 311 p. Bloomington, Indiana, Principia Press, 1932. ISIS

Reviewed by V. F. LENZEN, *Isis* 20, 491-92, 1934.

Karpinski, Louis C. Arithmetic centenarians : textbooks with a long life. *Scripta mathematica* 2, 34-40, 1933. ISIS

"Among textbooks of arithmetic the writer has found that there are roughly twenty which have been reprinted over a period of more than one hundred years. These centenarians, as I please to call them, may well be regarded as influential and worthy of some attention."

Lehmer, D. H. A photo-electric number sieve. *American Mathematical Monthly* 40, 401-06, 1933. ISIS

Sergescu, Petre. Gândirae matematica. VII+192 p. Cluj, "Ardealul," 1928. ISIS

Sergescu, Petre. Istoria calculului numeric. Resumatul lectiei facute la Universitatea populara "N. Iorga" din Valenii-de-Munte la 16 Iulie 1932. *Cuget Clar*, no. 11-12, 7 p., 1932. ISIS

Struik, D. J. Outline of a history of differential geometry (II). *Isis* 20, 161-91, 1933. ISIS

Contents : 6. GAUSS; 7. The French school of the forties; 8. RIEMANN; 9. The beginning of modern times; 10. Differential geometry from 1870 to 1900; 11. Sources; 12. Final remarks.

Struik, D. J. On the foundations of the theory of probabilities. *Philosophy of science* 1, 50-70, 1934. ISIS

"The foundation of the mathematical theory of probabilities is still a controversial subject. There are schools of insufficient reasoning and of cogent reasoning, of a priori determination and of frequency determination, of subjective and of objective probability. Two main difficulties exist. The first is the definition of equally like events. The second difficulty is the relation between the laws of causal natural science (mechanics, electro-

dynamics, etc.) and the laws of statistical regularity. Is it really necessary to add to the laws of mechanics one or more independent ' laws of large numbers ' to explain the regularities in dice throwing? In all these cases different answers exist, and the existence of a mathematical theory of probabilities remains a kind of miracle, as esoteric to the further domain of natural science as the resurrection of the dead."

Whitbrow, G. J. Continuity and irrational number. *Mathematical Gazette* 17, 151-57, 1933. ISIS

An historical sketch of these concepts from PYTHAGORAS to CANTOR. C. W. A.

Windred, G. The history of mathematical time. II. *Isis* 20, 192-219, 1933. ISIS

Contents: 5. The twentieth century; Time in modern mathematica physics; 6. Recent developments in the theory of time; Conclusion. Index.

III. — PHYSICAL SCIENCES (knowledge of inorganic nature)

22. — MECHANICS *(Including celestial and atomical mechanics)*

Durand, W. F. The development of our knowledge of the laws of fluid mechanics. *Science* 78, 343-51, 1933. ISIS

Sergescu, Petre. L'évolution des principes de la mécanique de NEWTON à LAPLACE. Appendix to *Annales de la Société Polonaise de Mathématiques*, 1929, 185-87. ISIS

23. — ASTRONOMY

Gilbert, C. S. Greenwich Observatory, 1675-1714. *The Observatory* 56, 22-26, 1933. ISIS

Gunther, Robert T. The astrolabes of the world. Based upon the series of instruments in the Lewis Evans Collection in the Old Ashmolean Museum at Oxford, with notes on astrolabes in the collections of the British Museum, Science Museum, Sir J. Findlay, Mr. S. V. Hoffman, the Mensing Collection, and in other public and private collections. Volume I. The Eastern astrolabes. XVII+III+304 p., 139 fig., 68 pl., frontisp. Vol. II. The Western astrolabes. VIII+p. 305-610, frontispiece, pl. 69-153, fig. 140-217. Oxford, University Press, 1932. ISIS

Reviewed by A. POGO, *Isis* 20, 310-16, 1933; 20, 492-95, 1934.

Sitter, Willem de. Kosmos. A course of six lectures on the development of our insight into the structure of the universe, delivered for the Lowell Institute in Boston, November 1931. VIII+138 p., 7 port., 5 pl. Cambridge, Harvard University Press, 1932. ISIS

Reviewed by N. T. BROBROVNIKOFF, *Isis* 20, 316-18, 1933.

Sitter, Willem de. Early astronomy and the Observatory of Leyden. *Nature* 132, 771-72, 1933. ISIS

"The Observatory of Leyden had really two founders, GOLIUS in 1633 and KAISER in 1861. I propose to make a comparison between these two epochs and the present time."

24. — PHYSICS

Burr, Alex. C. Notes on the history of the concept of thermal conductivity. *Isis* 20, 246-59, 1933. ISIS

"The concept of thermal conductivity required nearly three hundred years for its development and involved the expenditure of an immense amount of mental energy and experimental effort. GALILEO, HOOKE, NEWTON, BOERHAAVE, FRANKLIN, BLACK, RUMFORD, FOURIER—giants in the scientific world—contributed to the development of this concept. During the process of refinement and abstraction of ideas concerning the transfer of heat the thermometer and calorimeter were invented and the technique of their use perfected. The preliminary concepts of heat and flow of heat, of temperature as distinct from heat, of latent and specific heats, had to emerge. Conduction, as a method of heat transference, had to be separated and distinctly set apart from radiation and convection. Outmoded conceptions of heat served as guides in framing experiments and evaluating ideas. Theories rose and fell, arguments frequently waxed acrimonious, notions were confused; yet from this our present concept emerged, simple, useful, independent of any theory of heat."

Disney, Alfred N.; Hill, Cyril, F.; Baker, Wilfred E. Watson. Origin and development of the microscope. 303 p., 30 pl., 36 fig. London, Royal Microscopical Society, 1928. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 495-97, 1934.

Gliozzi, Mario. Le origini della fisica sperimentale: la determinazione del peso specifico dell'aria. *Periodico di matematiche*, 11, 1-10, 1931. ISIS

The earliest determinations of the specific weight of air as compared with water were as follows: "CARDANO 1:50; GALILEO 1:400; MERSENNE 1:1870; 1:255; DESCARTES 1:145; GUERICKE 1:780 (?); BOYLE 1:938; Accademia del Cimento 1:1438; BORELLI 1:1179; LANA 1:620." The correct value is 1:773. It is interesting to notice how very incorrect most of those determinations were. Barring the value given by GUERICKE which is doubtful

(in his *Experimenta nova* of 1672 he quotes no value—saying that the weight of air varies continually with the altitude and meteorological conditions), the best results were obtained by R. BOYLE (1661) and Father FRANCESCO LANA-TERZI (1670), their errors being almost equal but opposite. G. S.

Goodman, Herman. Story of electricity and a chronology of electricity and electrotherapeutics. With an introduction by VICTOR ROBINSON. New York, Medical Life Press, 1928. ISIS

A brief popular account of some of the important discoveries in the history of electricity. Illustrated. S. V. L.

25. — CHEMISTRY, PHYSICO-CHEMISTRY, INDUSTRIAL CHEMISTRY

Aston, F. W. The story of isotopes. *Science* 78, 5-6, 1933. ISIS

Browne, Charles Albert. Early references pertaining to chemical warfare. *Journal of Industrial and Engineering Chemistry*, 14, 3 p., 1922. ISIS

Browne, Charles Albert. The relation of chemistry to agriculture *Science* 60, 575-80, 1924. ISIS

Browne, Charles Albert. Chronological table of some leading events in the history of industrial chemistry in America from earliest colonial settlements until the outbreak of the World War. *Industrial and Engineering Chemistry* 18, 22 p., 1926. ISIS

Browne, Charles Albert. A half century of agricultural chemistry in America, 1876-1926. *Journal of the American Chemical Society* 48, 177-201, 1926. ISIS

Browne, Charles Albert. Historical notes upon the domestic potash industry in early colonial and later times. *Journal of Chemical Education* 3, 749-56, 1926. ISIS

Browne, Charles Albert. and **Louise McD.** American influences on chemical research and education in the Near East. *Journal of Chemical Education* 8, 1681-1702, illus., 1931. ISIS

Lamb, Arthur B. A century of progress in chemistry. *Science* 78, 371-76, 1933. ISIS

A popular address (The President's Address) delivered at an evening meeting of the American Chemical Society at the Century of Progress Exposition in Chicago, September 14, 1933.

Wruble, Milton. Studies in percolation. *Am. Journ. Pharm.* 105, nos. 5, 6 & 7, 1933. ISIS

The author has corrected several erroneous impressions prevalent in the United States concerning the early development of this process, which TSCHIRCH has pronounced the most important contribution made to Galenical pharmacy during the nineteenth century. This reprint, after a brief introduction, discusses the subject under the following captions: 1. REAL's " filtre-presse " and its modifications; 2. ROMERSHAUSEN's " Luft " and " Dampf-Presse "; 3. The contributions of the BOULLAYS ,père et fils; 4. Early developments in the U. S. The articles are illustrated with cuts of the early apparatus. E. K.

26. — TECHNOLOGY

(For mining, see 32. geology; for industrial chemistry, 25. chemistry. See also Arts and crafts under 45.)

Feldhaus, F. M. Geschichte der Technik in Russland. *Isis* 20, 445, 1934. ISIS

Short announcement (6 lines).

Hassler, Friedrich. Die Mechanisierung des Spinn- und Webprozesses als eine der Ursachen der „ industriellen Revolution". *Mitt. z. Gesch. d. Med.* 32, 299, 1933. ISIS

Jenkins, Rhys. Fire-extinguishing engines in England, 1625-1725. *Transactions of the Newcomen Society* 11, 15-25, 1930-31. ISIS

Scott, E. Kilburn. Memorials to pioneer Leeds engineers. *Transactions of the Newcomen Society* 11, 164-67, 1930-31. ISIS

Vowles, Hugh P. An inquiry into origins of the windmill. *Transactions of the Newcomen Society* 11, 1-14, 5 fig., 1930-31. ISIS

Contents: 1. Introductory; 2. HERON's " windmill "; 3. Early Persian windmills; 4. Transition from Persia to Western Europe.

IV. — BIOLOGICAL SCIENCES

(Knowledge of organic nature)

27. — BIOLOGY

(Generalities, " natural history ")

Conn, H. J. (editor). The history of staining. With contributions from LLOYD ARNOLD, A. F. BLAKESLEE, R. S. CUNNINGHAM,

S. I. KORNHAUSER, F. W. MALLORY, and EUGEN UNNA. 141 p. Geneva, N. Y., Biological Stain Commission, 1933. ISIS

The American Commission on the standardization of stains for use in the microscopical study of plant and animal tissues was established about 1919 under the chairmanship of the author of this book. The interest thus fostered has culminated in his *Biological Stains* (1925) and in this historical treatise.

SARRABAT (1733) and REICHEL (1758) both used stains to trace the ascent of fluids in wood, but the first use of dyes for the actual study of microscopic structure was that of Sir JOHN HILL (1770), in his *Construction of Timber*. EHRENBERG (1838) used granular dye stuffs to demonstrate the food vacuoles of the Infusoria, but not as intravitam stains. CORTI (1851) used carmin after fixation with corrosive sublimate, or other chemicals, to demonstrate the cellular structure of the epithelium of the cochlea. In this he followed GÖPPERT and COHN (1849) who had used cochineal and madder as dyes to differentiate cell structure. HARTIG, the botanist, also used carmin (1854) to demonstrate the nuclei and chromoplasts or plant cells.

The anatomist GERLACH (1858) extended the method to dead animal tissues to reveal their finer structure. The apothecary MASCHKE (1859) recommended dyes as reagents for the study of both the anatomy and the chemistry of plants. Indigo was introduced by him for histological work. Anilin dyes were first used in histology by BENEKE (1862), logwood by WALDEYER (1863), and hematoxylin by BÖHMER (1865). Nine portraits and ample bibliographies add to the historical values of this unique history of the microscopical techniques on which modern histology, embryology, cytology, and cytogenetics have been based. C. A. K.

Fischer, R. A. Indeterminism and natural selection. *Philosophy of science* 1, 99-117, 1934. ISIS

Landman, J. H. Human sterilization. XVIII+341 p., 5 fig. New York, MACMILLAN, 1932 ($4.00). ISIS

The present status of the sterilization movement, aimed against the perpetuation of socially inadequate elements in the population, is authoritatively presented from various points of view in this treatise. The basis and growth of eugenics, the statutory and judicial history of human steri'ization legislation in the United States, the attitude of the courts, the trend of legal decisions, the biologic and eugenic bases of compulsory sterilization, analyses of various types of dysgenic individuals, the surgery of various modes of sterilization, and their legal status and the administrative problems in the enforcement of the laws, are all reviewed in the light of accumulated experience of the formative years of this movement. Twenty-seven states have legally authorized sterilization and over twelve thousand persons have been sterilized in the U.S.A. C. A. K.

Weinstein, Alexander. PALAMEDES. *American Naturalist* 67, 32 p., 1933. ISIS

Penetrating discussion of the principles and applications of eugenics. PALAMEDES was the greatest of the Greeks who fought before Troy; he is

almost forgotten, while we all remember the wisdom of NESTOR and ODYSSEUS. " NESTOR, however, was wise only in the sense that being very old he could remember many things; and ODYSSEUS was not wise at all but merely unscrupulous." ... " If we are to make a better world, we must breed people like PALAMEDES; the danger is that we shall breed people like ODYSSEUS instead." G. S.

28. — BOTANY

(Agronomy, phytopathology, palaeobotany)

Browne, Charles Albert. Some historical relations of agriculture in the West Indies to that of the United States. *Agricultural History* 1, 23-33, 1927. ISIS

Browne, Charles Albert. The origins of sugar manufacture in America. I. A sketch of the history of raw cane-sugar production in America. II. A sketch of the history of sugar refining in America. *Journal of Chemical Education* 10, 39 p., 38 fig., 1933. ISIS

Leclerc, Henri. Les vieilles panacées : La livèche (ligusticum levisticum L.). *Janus* 37, 281-92, 1933. ISIS

Marzell, Heinrich. Die Frühlingsblumen im antiken und neuzeitlichen Zauberglauben. *Mitt. z. Gesch. d. Med.* 32, 299, 1933. ISIS

Sarton, George. Introduction of cacti and other Cactaceae into Europe. Query no. 33. *Isis* 20, 442, 1934. ISIS

29. — ZOOLOGY

Bilikiewicz, Tadeusz. Die Embryologie im Zeitalter des Barock und des Rokoko. 183 p., 18 fig. (Arbeiten des Instituts für Geschichte der Medizin an der Universität Leipzig, 2). Leipzig, THIEME, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 497, 1934.

Galloway, J. J. A manual of foraminifera. XIV+483 p., 42 pl. (James Furman Kemp memorial series, no. 1). Bloomington, Indiana, Principia Press, 1933. ISIS

Reviewed by CHARLES A. KOFOID, *Isis* 20, 498-99, 1934.

V. — SCIENCES OF THE EARTH
(implying knowledge of both organic and inorganic nature)

31. — GEOGRAPHY AND OCEANOGRAPHY

Hinks, Arthur R. Maps and survey. Third edition. XIV+284 p., 28 pl. Cambridge, University Press, 1933. ISIS

The author writes : " Since the last edition the subject has changed much. The present work has therefore been extensively altered and largely re-written. A brief chapter on early maps has been prefixed to the treatment of the modern, and a few pieces of typical maps have been reproduced to show the style of early periods. The maps analysed have mostly been published since the War. It seemed best to enlarge the analysis and discard the illustration. I have made some attempt to deal with the new and difficult subject of air survey; the chapter on geodesy has been entirely rewritten; and the sections on stereographic survey much extended to cover important advances in this delightful subject. If these sections seem to be disproportionate in detail and in difficulty to the rest of the book, it is because the subject is new, and not as yet generally treated in textbooks. "

Hobbs, William Herbert. Visibility and the discovery of Polar lands. *Geografiska Annaler*, H. 2 o. 3, 217-24, 6 fig., 1933. ISIS

" All explorers with experience in the polar regions have borne testimony to the at times exceptional visibility and to the quite remarkable effects of mirage, and the evidence has sometimes been even more glaringly, though generally unconsciously, set forth upon their maps. The part which these conditions have played in the discovery of polar coastlands has, however, not been understood, but it must be taken into account if their history is to be correctly appraised and future errors avoided. The amazing distances at which landmarks have been occasionally made out within the polar regions are explained chiefly by two factors—the excessive clarity of the atmosphere due to absence of moisture and dust under special conditions, and to the temperature inversions within its lower strata."

32. — GEOLOGY, MINERALOGY, PALAEONTOLOGY, MINING

(For palaeobotany, palaeozoology and palaeoanthropology, see respectively, 28. *botany,* 29. *zoology and* 39. *prehistory)*

Adams, Frank D. Earliest use of the term geology. *Bulletin of the Geological Society of America* 43, 121-23, 1932. ISIS

" While the word ' geology,' in its present or approximately its present sense, so far as the writer can ascertain, first appears in LOVELL's book in 1661, it is interesting to note that it was used very much earlier but in an entirely different sense by RICHARD DE BURY, Bishop of Durham, in his very interesting and entertaining work ' Philobiblon,' or the ' Love of books'.

In this book, which was first printed in 1473 at Cologne, and which has been translated into English by E. C. THOMAS and published by the De La Mare Press of London in 1903, the word ' geologia ' it is believed made its first appearance in literature. It was apparently invented, if this term may be used, by DE BURY. He used it, as stated above, in an entirely different sense from that in which it subsequently came to be employed. By it he designated the study of law, which faculty, he says, ' We may call by a special term ' Geologia ' or the earthly science ' as contrasted with the arts and sciences, as these terms were then employed, which are concerned with spiritual things."

Adams, Frank D. Further note on the earliest use of the word " geology." *Bulletin of the Geological Society of America* 44, 821-26, 1933. ISIS

" LOVELL's work ' Pammineralogicon or an Universal history of minerals, etc.,' published in 1661, to which reference has already been made, is the first work in the English language in which the word, ' geologia,' appears. The work of ESCHOLT, written in the Danish language but published in Christiania in 1657, is the first printed work in which the word occurs. But ALDROVANDUS employed the word, in some manuscript notes and in his will, essentially in its modern sense, at least as early as 1605, being the year in which he died."

Lones, T. E. The South Staffordshire and North Worcestershire mining district and its relics of mining appliances. *Transactions of the Newcomen Society* 11, 42-54, 1930-31. ISIS

Merriam, John C. Crater Lake. A study in appreciation of nature. *American Magazine of Art*, 3 p., illus., August 1933. ISIS

Merriam, John C. The unity of nature as illustrated by the Grand Canyon. *Scientific Monthly* 33, 227-34, 1931. ISIS

" It has been stated that nowhere more clearly than at the Grand Canyon does evidence of interrelation in elements and unity of action impress itself upon scientist or investigator. Through such visualization of nature seen as a whole we come often to realization that, even when enlarged by the lens of knowledge, the picture indicates the presence of something beyond that vision does not fully reach. So, in various other ways, artist and writer have presented the idea that, in looking upon these great examples of unity in nature, what we see may be only the shadowy expression of things greater still, which neither eye nor mind has yet been able to define."

Peake, Harold. The origin and early spread of ironworking. *Geographical Review* 23, 639-52, 1 fig., 1933. ISIS

Contents : Early use of meteoric iron; Beginnings of the iron age; The Hittite Empire; Anatolian sites of early iron production; Date of the Hittite iron industry; Dispersion of the ironworkers; The spread westward; Iron reaches Italy and Central Europe; Iron in India and China; Ironworking in Africa; Australia and the New World.

Ruska, Julius. Über Nachahmung von Edelsteinen. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 108-19, 1933. ISIS

1. Die Rezepte des Papyrus Holmiensis; 2. Spätgriechische Rezepte; 3. Syro-arabische Rezepte; 4. Rezepte für farbige Gläser.

VI. — ANTHROPOLOGICAL AND HISTORICAL SCIENCES
(Knowledge of man, past and present)

36. — PHYSIOLOGY
(Human and comparative)

Bohr, Niels. Licht und Leben. *Die Naturwissenschaften* 21, 245-50, 1933. ISIS

Kotsovsky, D. Das Alter in der Geschichte der Wissenschaft. *Isis* 20, 220-45, 1933. ISIS

"Der Tod aus Altersschwäche als allgemeinbiologische Erscheinung. Primitive Versuche des Altersstudiums. Erforschung und Altersbekämpfung im Mittelalter. Anatomische, funktionale, biologische und biochemische Alterstheorien aus der neuesten Zeit zum Zweck der Aufklärung des Altersmechanismus. Zusammenfassung."

Wodlinger, Mark H. Bibliographical survey of vitamins, 1650-1930, with a section on patents. Compiled by ELLA M. SALMONSEN. Chicago, The Author, 1932. ISIS

Reviewed by C. A. KOFOID, *Isis* 20, 318, 1933.

38. — ARCHAEOLOGY
(Generalities, methods)

Carpenter, Rhys. The humanistic value of archaeology. 134 p. Cambridge, Mass., Harvard University Press, 1933 ($1.50). ISIS

The fourth volume of the Martin Classical Lectures, founded in honor of CHARLES BEEBE MARTIN at Oberlin College, deals with the theme of the effect of classical archaeology in widening human horizons. The author surveys the contributions of this rapidly developing science to the study of classical architecture, of Greek literature, of sculpture, and of painting. Archaeology is likened to the natural sciences of geology and botany, which have passed through the earlier stages of collecting and classification to the later ones of historical continuity and dynamic geomorphism in the first, and comparative morphology and genetics in the second. Archaeology, too, has become a natural science through the application of the comparative and genetic or evolutionary methods. It is, however, not in its scientific aspect that archaeology has greatest values, but in its relations to humanism.

It is only as archaeology illuminates the traditional classical humanism that it deserves to shed its beam at all. In its survey of the rise and fall of cultures and of forms of art it enables the scholar of the present to front the seeming chaos of the modern world with equanimity and with understanding instead of bewilderment of incomprehension. To understand is to be sane.

C. A. K.

Roys, Ralph L. The book of CHILAM BALAM of Chumayel. VIII + 229 p., pl., 48 fig., map. Washington, Carnegie Institution, 1933.

ISIS

"Among the various avenues of approach to the investigation of Maya civilization, the study of the native literature of Yucatan is, next to the actual archaeological exploration of the remains, one of the most promising, for it contains much of what the Indians remembered of their old culture after the Spanish Conquest. The Books of CHILAM BALAM form the most important part of this native Maya literature. Written in the Maya language, they reflect more closely the thought of these Indians than any other records that have come down to us. Not only do they contain a wealth of historical and ethnological information invaluable to the student of the pre-Columbian career of the Maya, but they also furnish a record of the reactions of the native mind to the European culture and of the manner in which the latter was adapted to suit its new environment. It is hardly necessary to dwell upon the value of these old texts to the linguistic student. The translation of the Book of CHILAM BALAM of Chumayel depends primarily upon the reading given to the badly punctuated and often misspelled Maya text, and such a reading is based upon an extensive comparison with other similar texts. The difficulties of translation are not to be underestimated, but they can be greatly lessened by such a comparison." Very valuable edition of the Maya text followed by the English version with abundant notes. Some chapters are of especial interest to the historian of primitive science: 6. Notes on the calendar, 8. Notes on astronomy, 10. The creation of the world. The prophet BALAM of Chumayel who wrote or compiled this book lived at the end of the fifteenth century and the beginning of the sixteenth; he foretold the coming of strangers from the east who would establish a new religion. His prophecies were written in the Maya language but in European script. This edition would deserve to be analyzed and discussed in *Isis*, and I would gladly give my copy for that purpose to any competent scholar. G. S.

39. — PREHISTORY

Lietzmann, W. Geometrie und Prähistorie. *Isis* 20, 436-39, 2 pl., 1934.

ISIS

"Der Ursprung der Mathematik wird vielfach aus den Bedürfnissen des täglichen Lebens (Feldmessung, Hausbau, Kulthandlung) hergeleitet, so wie es schon HERODOT, von den Aegyptern sagt. Mir will scheinen, als ob ebenso ein Gefühl aesthetischer Freude an der reinen geometrischen Form eine Quelle der Mathematik gewesen ist. Es wäre im Hinblick darauf gewünscht, wenn diesen Beziehungen zwischen Ornament und geometrischer Figur in der Prähistorie weiter nachgegangen würde. Ich will nur darauf

hinweisen, dass merkwürdigerweise ebenso wie in der systematischen Geometrie auch im Ornament das Dreieck vor dem Viereck, der Rhombus und das Rechteck vor dem Quadrat betont zu sein scheint."

Peake, Harold J. E. Early steps in human progress. XII+256 p., 74 pls. Philadelphia, LIPPINCOTT, 1933 ($3.00). ISIS

The author presents a well-organized account of the evidence of the origins of the varied elements of human culture and of the early steps in their evolution. The book opens with a brief review of the origin and the distinctive features of the races of men and a discussion of the measurement of time since the glacial epoch, in the ages of man during the Pleistocene, during the Egyptian dynasties, and in the Minoan periods. In later chapters the author traces the evidence for the making of tools; the discovery of fire; the hunter's weapons; the beginnings of art; the weaving of baskets and utilization of leather; the domestication of animals; the cultivation of grain; the earliest agricultural implements, and mills for grinding grains; the evolution of the house; the potters' art; the weaving of textiles; transport by land and by water; the use of copper, meteoric iron, and bronze; the invention of writing; the beginnings of trade; the weapons of war; and the forging of iron. The work is abundantly illustrated and the evidences are assembled from a wide range of sources with skill and judgment. C. A. K.

Peake, Harold J. E. The term " Mesolithic." *Nature* 133, 104, 1934. ISIS

Völter, Daniel. Glozel und die Einwanderung von Semiten im heutigen französischen Department Allier um 700 vor Chr. VIII+221 p., 110 fig., pl. Strassburg, HEITZ, 1929. ISIS

Reviewed by DAVID RIESMAN. *Jewish Quarterly Review* 24, 155-56, 1933.

Völter, Daniel. Die Inschriften von Glozel. Eine Auseinandersetzung mit Dr. A. MORLET in Vichy. VI+54 p., figs., pl. Strassburg, HEITZ, 1930. ISIS

Reviewed by DAVID RIESMAN, *Jewish Quarterly Review* 24, 155-56, 1933.

40. — ETHNOLOGY

(Primitive and popular science)

Marshall, Roy K. LUDENDORFF's studies in the astronomy of the Mayas. *Journal of the Royal Astronomical Society of Canada* 27, 11-26, 1933. ISIS

Richeson, A. W. The number system of the Mayas. *American Mathematical Monthly* 40, 542-46, 5 fig., 1933. ISIS

" It is quite evident that the Mayas had developed a number system with a place value for their characters many years before the advent of the white

man. Dr. TEEPLE is of the opinion that the Mayan vigesimal system of numbers was a distinct part of an American civilization. The records also indicate that the Mayas were unable to handle fractions as we do today, but on the other hand they were able to and did perform long numerical computations involving multiplication and division. Just how these computations were carried out we do not know. Dr. FÖRSTEMANN in his works gives an instance from the inscriptions where the calculation runs into the millions."

Thompson, Stith. Motif-index of folk-literature. Volume two : D-E. 435 p. (*Indiana University Studies*, 20, no. 100). Bloomington, Ind., 1933. ISIS

The purpose and plan of this work was discussed in *Isis*, 20, 607, when vol. 1 appeared in 1932. Vol. 2 contains chapters D and E subdivided as follows. Chapter D. Magic : transformation; magic objects; magic powers and manifestations. Chapter E. The dead : resuscitation; ghosts and other revenants; reincarnation; the soul. Each of these parts is subdivided into smaller ones according to the decimal system. For ex. D 1960 is " magic sleep," then D 1960 .1 is The Seven sleepers and RIP VAN WINKLE, D 1960.3 is the motif of the Sleeping beauty, etc. This undertaking interests me very much, and I am sure it will prove very valuable. G. S.

41. — SUPERSTITION AND OCCULTISM

Browne, Charles Albert. Observations upon the use of the divining rod in Germany. *Science* 73, 84-86, fig., 1931. ISIS

44. — HISTORY OF CIVILIZATION

(General history, historical methods, biography and chronology)

Browne, Charles Albert. The comparative value of methods for estimating fame. *Science* 33, 770-73, 1911. ISIS

Delevsky, J. Cosmogonie et philosophie de l'histoire. *R. Philos.* 116, 239-73, 1933. ISIS

(**History**). List of doctoral dissertations in history now in progress at the chief American universities, December 1933. 64 p. Washington, Department of Historical Research, Carnegie Institution. ISIS

46. — HISTORY OF LANGUAGE, WRITING AND LITERATURE

Doroszewski, W. Quelques remarques sur les rapports de la sociologie et de la linguistique : DURKHEIM et F. DE SAUSSURE, *J. de psychologie* 30, 82-91, 1933. ISIS

Je prends prétexte de cette étude pour signaler un nº exceptionnel (496 p.) du *Journal de psychologie normale et pathologique* (30e année, 15 janv.-15 avril, 1933) entièrement consacré à la psychologie du langage. 24 études y sont groupées sous les titres suivants : Théorie du langage; linguistique générale; système matériel du langage; système formel du langage; acquisition du langage; pathologie du langage. L. G.

Février, J. G. La genèse de l'alphabet d'après les découvertes récentes. *R. d'hist. de la philos. et d'hist. génér. de la civilisation* 1, 100-20, 1933. ISIS

Marouzeau, J. Lexique de la terminologie linguistique. 205 p. Paris, GEUTHNER, 1933 (40 frs.). ISIS

" Le présent Lexique est né d'abord du désir de rendre accessibles aux non spécialistes les travaux des linguistes et des grammairiens. La linguistique, constituée au cours du siècle dernier, a eu besoin, comme toute science nouvelle, d'une terminologie adaptée à son objet; elle se l'est construite, au hasard des découvertes et des inspirations, en utilisant la nomenclature grammaticale traditionnelle, complétée soit par appel à diverses langues modernes, soit à l'aide de néologismes formés d'éléments gréco-latins. Quantité de termes ont été créés, quantité d'autres ont été détournés de leur acception ancienne. Il en est résulté une grande diversité et une grande incertitude, propres à empêcher les non initiés de comprendre les savants, et quelquefois les savants de se comprendre exactement entre eux. Par exemple nous confondons souvent en français attribut et prédicat, actif et transitif, ton et accent, nom et substantif, complément et régime, etc. " L'utilité de cet ouvrage est encore augmentée par un index allemand. G. S.

48. — HISTORY OF PHILOSOPHY

(See also above 18. *Philosophy of science)*

Bréhier, Emile. Histoire de la philosophie allemande. 2e éd. 187 p. Paris, VRIN, 1933. ISIS

Carnap, Rudolf. On the character of philosophic problems. *Philosophy of science* 1, 5-19, 1934. ISIS

Souilhé, Joseph ; Brémond, A. ; Mugnier, R. Etude historique de la philosophie. 187 p. Paris, BEAUCHESNE, 1932. ISIS

VII. — MEDICINE

50. — HISTORY, ORGANIZATION, AND PHILOSOPHY OF MEDICINE

Bertone, Carlo. Per la storia dell' igiene in Piemonte : i protomedici generali dall' epoca di EMANUELE FILIBERTO in poi. *Rivista di storia delle scienze mediche* 24, 19-20, 1 facs., 1933. ISIS

Bishop, W. J. The autobiographies of British medical men. *Proceedings of the Royal Society of Medicine*, 26, 16-22, London, 1933. ISIS

The author, librarian of the Royal College of Physicians, London, has prepared a useful list of British medical autobiographies. He includes diaries and reminiscences. H. R. V.

Castiglioni, Arturo. The Renaissance of medicine in Italy. XIV + 91 p., port. (Publications of the Institute of the History of Medicine, the Johns Hopkins University, 3rd series, 1). Baltimore, Johns Hopkins Press, 1934 ($1.50). ISIS

These are the Hideyo Noguchi lectures delivered in Baltimore in 1933 : 1. The dawn of the Renaissance in the life, art and science of Italy—the thought of LEONARDO; 2. The flowering of medical studies at the Italian universities from BERENGARIO to CESALPINO; 3. The legacy of scientific Renaissance and the main currents of thought from FRACASTORO to GALILEO. Together with a spirited preface by SIGERIST and a beautiful portrait. A charming little book. G. S.

Creutz, Rudolf. Der historische Streit des 16.-18. Jahrhunderts über die beiden Thesen : " Medicos sexcentis annis Roma exulasse " und " Medicus Romanus servus sexaginta solidis aestimatus." *Mitt. z. Gesch. d. Med.* 32, 296, 1933. ISIS

Cyriax, Edgar. On some points as regards priority in mechano-therapeutics. Third communication. *Janus* 37, 271-74, 1933. ISIS

Diepgen, Paul. Die Medizingeschichtsschreibung der letzten 80 Jahre. *Mitt. z. Gesch. d. Med.* 32, 297, 1933. ISIS

Garrison, Fielding H. Revised students' check-list of texts illustrating the history of medicine, with references for collateral reading. *Bulletin of the Institute of the History of Medicine* 1, 333-434, 1933. ISIS

New edition of the list originally published in the Index Catalogue of the Surgeon General's Library, 1912, 2. p., xvii, 89-178. Valuable list which

would have been more valuable still if it had been completed by an index.
G. S.

Gibson, A. G. The physician's art. 240 p. Oxford, Clarendon Press, 1933. ISIS

"In 1669 JOHN LOCKE wrote a fragment, 'De arte medica,' in which he considered the nature of the healing art. Dr. GIBSON prints this fragment in the front of his book, which he describes as an attempt to expand LOCKE's design upon a basis of similar general beliefs and assumptions. It is in fact a meditation upon the character of the good physician, by one who has had long and wide experience, including the experience of teaching in a great school of medicine. Its chapters treat 'Of art and science', 'Of diagnosis', 'Of prognosis', 'Of treatment', of 'The ethics and management of practice', 'Of the doctor himself', and of 'Optimism'. Laymen as well as fellow physicians will read this humane, reflective, and untechnical discussion of the physician's art."

Hurd-Mead, Kate Campbell. An introduction to the history of women in medicine. II. Medical women of the Middle Ages. *Annals of Medical History* 5, 484-504, 584-600, 1 fig., 1933. ISIS

Kemble, James. Occupational diseases: A historical note. *Proceedings of the Royal Society of Medicine* 26, 33-36, London, 1933. ISIS

Leake, Chauncey D. State medical library of California. A survey of the first year's work. *California and Western Medicine* 38, 4 p., 1933. ISIS

Lindsay, Lilian. The sun, the toothdrawer and the saint. (The C. E. Wallis Memorial lecture). *Proceedings of the Royal Society of Medicine*, 26, 33-44, London, 1933. ISIS

The author reviews the literature of ancient materia medica, folklore and hagiology, noting that there were many superstitions regarding the teeth. They, the most indestructible part of the body, were connected with the sun, both symbols of vitality and immortality. In the earliest codes of laws severe penalties were exacted from persons who deprived another of his teeth. In his paper LINDSAY gives many references to support his viewpoint. As the tooth was considered as divine, the toothdrawer was despised and could only be recruited from the lowest grades of society. The saint called upon by the toothdrawer was ST. APPOLLONIA, not mentioned before the end of the fourteenth century. The whole lecture is an important addition to our scant knowledge of the subject. H. R. V.

Pusey, William Allen. The history of dermatology. XVII+233 p. 32 illus. Springfield, Ill., THOMAS, 1933. ISIS

Reviewed by C. D. LEAKE, *Isis* 20, 504-05, 1934; by LÉON BRODIER, *Bull. de la Soc. franç. d'hist. de la méd.* 27, 317-18, 1933.

Robinson, Victor. Landmarks in modern medicine. A chronology with texts and eponyms. *Medical life* 40, 391-400, 1933. ISIS

BICHAT to RUDOLF MAGNUS (1800-1924).

Sigerist, Henry E. Amerika und die Medizin, 352 p., 30 fig., 2 maps. Leipzig, THIEME, 1933 (M. 8.50 ; geb. M. 9.60). ISIS

It is sufficient to announce the publication of this history of American medicine written by a master hand. Any person interested in the subject may be sure to find in this book as much information as can be put together within 352 p., plus bibliographical guidance for further study. There are a number of well chosen illustrations. The text is divided as follows : 1. Physical background; 2. Colonial times; 3. The United States; 4. Pioneers; 5. Medical teaching; 6. Physician and patient; 7. Hospitals; 8. Prophylaxy; 9. Science. G. S.

Sigerist, Henry E. Grosse Ärzte. Eine Geschichte der Heilkunde in Lebensbildern. 2. Aufl. 316 p., 69 fig. München, LEHMANN, 1933. ISIS

Sigerist, Henry E. The great doctors, a biographical history of medicine. Translated by EDEN and CEDAR PAUL. New York, NORTON, 1933. ISIS

Reviewed in *Annals of Medical History* 5, 603, 1933.

Smith, Sir **Frederick.** The early history of veterinary literature and its British development. Vol. 4 : The nineteenth century, 1823-1860. Edited, with a memoir of the author, by FRED BULLOCK. XXIV+161 p., 12 port. London, BAILLIÈRE, TINDALL and COX, 1933 (15/-). ISIS

This closing volume of FREDERICK SMITH's *History of veterinary literature* brings the subject up to 1860. It deals with the lives and publications of the leading members of the faculties of the Veterinary Schools of Edinburgh and of London, and of the Royal College of Veterinary Surgeons. The rivalries of these schools and the militant policies of their respective journals form a noticeable element in the biographical portions of the work. The literature of the period in the form of books is critically reviewed and the scientific contributions of certain leading veterinarians are summarized. The history of certain outbreaks of animal plagues, such as cattle plague and anthrax, in Great Britain is traced and their relations to ignorance of epidemiology and quarantine are noted. Twelve portraits of British leaders of veterinary education and research are included. C. A. K.

Thoms, Herbert. Chapters in American obstetrics. X+90 p., 10 ills. Springfield, Ill., THOMAS, 1933. ISIS

Reviewed by C. D. LEAKE, *Isis* 20, 503, 1934.

51. — EPIDEMIOLOGY, HISTORY OF SPECIAL DISEASES. PUBLIC HEALTH AND SOCIAL MEDICINE

Cawadias, A. P. Gastro-enterology and metabolism : a historical survey. *Proceedings of the Royal Society of Medicine* 26, 43-50. London, 1933. ISIS

The broad outlines of the historical development of the subject are given, without reference. H. R. V.

Duguet, le docteur. Le pèlerinage de la Mecque au point de vue religieux, social et sanitaire. Préface de JUSTIN GODART. XII + 357 p., 8 pl., Paris, RIEDER, 1932. ISIS

Reviewed by GEORGE SARTON, *Isis* 20, 499-503, 1934.

Essed, W. F. R. Syphilis en framboesia. *Bijdragen tot de geschiedenis der geneeskunde* 13, 274-76, 1933. ISIS

Goldberg, Ada ; Saye, Hymen. An index to mediaeval French medical receipts. *Bulletin of the Institute of the History of Medicine* 1, 435-66, 1933. ISIS

" This index was undertaken by the writers upon the suggestion of Professor DAVID S. BLONDHEIM to facilitate the study of the scattered French medical receipts of the Middle Ages that have been published."

Jegel, August. Die Geschlechtskrankheiten sind vor der Entdeckung Amerikas auch in Franken bekannt. *Archiv für Geschichte der Medizin* 26, 289-309, 1933. ISIS

Lint, J. G. de. Syphilis en framboesia. *Bijdragen tot de geschiedenis der geneeskunde* 13, 214-16, 1933. ISIS

Sigerist, Henry E. The philosophy of hygiene. *Bulletin of the Institute of the history of medicine* 1, 323-31, 1933. ISIS

Sticker, Georg. Hiera nousos. *Quellen und Studien zur Gesch. d. Naturw. u. d. Med.* 3, H. 4, 139-50, 1933. ISIS

On epilepsy in ancient Greek literature. G. S.

Stolkind, E. History of bronchial asthma. *Janus* 37, 300-19, 1933. ISIS

Stolkind, E. The history of bronchial asthma and allergy. *Proceedings of the Royal Society of Medicine* 26, 36-42, London, 1933. ISIS

This paper is a brief review of the history of asthma and the more recent

term, allergy. The first clear description of bronchial asthma was given by AURELIANUS in *De morbis acutis et chronicis*. STOLKIND then traces the history of the disease through MOSES MAIMONIDES, VAN HELMONT, BONETUS to THOMAS WILLIS, who recognized its nervous origin (1680). There were many treatises on asthma in the eighteenth century. The modern conception of the disease was first noted by SALTER (1868). That asthma is an anaphylactic or allergic disease is now supported by the majority of physicians. STOLKIND's report is an important review of the subject, although only given in an abridged form. A list of references is appended. H. R. V.

Townsend, John F. History of influenza epidemics. *Annals of medical history* 5, 533-47, 1933. ISIS

52. — HISTORY OF HOSPITALS, OF MEDICAL TEACHING, AND OF THE MEDICAL PROFESSION

Riesman, David. Medicine at the bar of public opinion. *American Medical Association Bulletin* 19, 227-30, 1924. ISIS

Riesman, David. The organization of the medical clinic. *Bulletin of the American College of Surgeons*, 24-26, April 1926. ISIS

Riesman, David. Medical education and the distribution of physicians in the United States. *Atlantic Medical Journal*, 4 p., Oct. 1927. ISIS

Riesman, David. Relations and functions of the clinical pathologist in the hospital staff. *American Journal of Clinical Pathology* 2, 6 p., 1932. ISIS

Saint-Jacques, Et. Histoire médicale de Montréal (Canada) Ville-Marie sous le régime français (1642-1760). *Bulletin de la société franç. d'hist. de la méd.* 27, 229-34, 1933. ISIS

Sigerist, Henry E. The physician's profession through the ages. *Bulletin of the New York Academy of Medicine* 9, 661-76, 1933. ISIS

53. — PHARMACY, PHARMACOLOGY, TOXICOLOGY

Kremers, Edward. Introductory lecture to a course in history of pharmacy. *Journal of the American Pharmaceutical Association* 22, 1270-79, 1933. ISIS

Kremers, Edward. The guild of physicians, apothecaries and merchants in Florence at the beginning of the 14th century, and at the close of the 15th century. Query no. 34. *Isis* 20, 442, 1934. ISIS

Kremers, Edward. History of pharmacy. *Isis* 20, 447, 1934. ISIS

Lulofs, P. K. Drossaart. Een en ander uit de geschiedenis der kina. *Bijdragen tot de geschiedenis der geneeskunde* 13, 201-12, 1933. ISIS

VIII. — EDUCATION

(The methods of accumulating, imparting and diffusing knowledge)

54. — EDUCATION

(Generalities, methods, colleges, universities)

Castiglioni, Arturo. Gli studenti di medicina polacchi all' Università di Padova. *Atti della Società Italiana di storia delle scienze mediche e naturali*, 62-81, 1933. (Appended to *Rivista di storia delle scienze mediche e naturali* 24, 1933). ISIS

Irsay, Stephen d'. Histoire des universités françaises et étrangères des origines à nos jours. T. I, Moyen Age et Renaissance. XII+ 372 p., 20 pl. Paris, PICARD, 1933. ISIS

Reviewed by G. C. SELLERY, *American Historical Review* 39, 301-03, 1933; by GAINES POST, *Speculum* 9, 102-05, 1934; by HÉLÈNE METZGER, *Archeion* 15, 298-300, 1933.

56. — BIBLIOGRAPHY

(Methods, libraries)

Isis, no. 58 (vol. 20, 1, 320, p. 4 pl.) Bruges, November 1933. ISIS

Isis, no. 59 (vol. 20, 2, p. 321-628, 4 pl.) Bruges, January 1934. ISIS

These two numbers are analyzed in the 40th Critical Bibliography. Every previous number has been analyzed in previous bibliographies. G. S.

(Uppsala). Uppsala Universitets Biblioteks Minnesskrift 1621-1921. Med Bidrag av bibliotekets forna och nuvarande tjänstemän. IX+ 622 p., figs., port., Uppsala, ALMQVIST & WIKSELL, 1921. ISIS

57. — MUSEOLOGY

(Museums and collections)

Grimshaw, Percy H. The Royal Scottish Museum, Edinburgh. *Natural History Magazine* 4, 1-12, 1933. ISIS

Established 1854. C. W. A.

Lönnberg, Einar. The Natural History Museum (Natur-Historiska Riksmuseum) Stockholm. *Natural History Magazine* 4, 77-93, 1933. ISIS

Includes historical notes. C. W. A.

Zimmer, C. The Natural History Museum (Das Museum für Naturkunde), Berlin. *Natural History Magazine* 4, 37-47, 1933. ISIS

Includes historical notes. C. W. A.

58. — CATALOGUES OF SECOND-HAND BOOKS ON THE HISTORY AND PHILOSOPHY OF SCIENCE

Many catalogues of second-hand books are so interesting and so full of valuable information that we shall henceforth register them in this section, together with other lists of a similar nature, such as catalogues of scientific medals and prints. When applying to the publishers of these catalogues for a copy, please mention *Isis*.

Art ancien, S. A., L'. Short list 4, early books. 56 p., 430 items. Zurich, Spelikanstrasse, 1934. ISIS

Contents : Medicine and natural science, no. 490-807; Travels, geography, etc., no. 808-900; Supplement. (medicine etc.) no. 901-920.

Baer, Joseph. Kunstbibliothek des Kommerzienrats EDUARD BEIT von Speyer. Moderne Bibliothek eines Frankfurter Bibliophilen. Inkunabeln, Manuscripte & Americana aus dem Besitze eines norddeutschen Sammlers. Kölner Inkunabeln aus Rheinischem Privatbesitz. 98 p., 887 items, ills. Frankfurt a.M., Hochstr. 6. ISIS

17. Medizin und Naturwissenschaften; 21. Physik, Astronomie, Mathematik und Technik.

Deutsche Buch-Club, Der. Autographen I. 48 p., 663 items. Antiquariats-Katalog 15. Dr. ERNST L. HAUSWEDELL, Mönckebergstrasse 21, Hulbe-Haus, Hamburg 1, 1934. ISIS

Fiedler, Henry George. Catalogue of books on natural history : zoology, botany, geology. No. 51. New York, 89 Chambers St., 1933. ISIS

Fiedler, Henry George. Catalogue of periodicals on chemistry, physics, astronomy, electricity, engineering, metallurgy, mining, geology, technology. With a selection of books on the exact sciences. 16 p. New York, 89 Chambers St., 1933. ISIS

Fock, Gustav. Evertebrata. Enthält ein Angebot von Zeitschriften,

Büchern und Monographien zum Teil aus dem Besitze von A. SCHUBERG-Berlin und L. DÖDERLEIN-München. 137 p. 3703 items. (Antiquariatskatalog Nr. 678). Leipzig C1, 1933. ISIS

Contents: 1. Scripta miscellanea; 2. Protozoa; 3. Coelenterata; 4. Echinodermata; 5. Vermes; 6. Tunicata; 7. Bryozoa, Brachiopoda; 8. Mollusca; 9. Crustacea; 10. Arachnoidea, Myriopoda; 11. Insecta (Anatomie u. Physiologie); 12. Acta et periodica.

Fock, Gustav. Geschichte der Medizin und Naturwissenschaften. Antiquariatskatalog Nr. 685. 1753 items. Schlossgasse 7-9, Leipzig C1, 1933. ISIS

Contents: I. Geschichte der Medizin und Naturwissenschaften; II. Medizinische Autoren des Altertums und des Mittelalters; III. Auswahl älterer und wertvoller medizinischer Zeitschriften.

Fock, Gustav. Physiologie (incl. Biochemie, Pharmakologie, Toxikologie). Z. Tl. aus den Bibliotheken der Herrn Professoren A. KREIDL (Wien), A. KOSSEL (Heidelberg), H. LEO (Bonn), L. LEWIN (Berlin), J. POHL (Breslau), H. WIELAND (Heidelberg), F. HOFMANN (Berlin), J. N. LANGLEY (Cambridge). 112 p., 2526 items (Nr. 684). Leipzig C1, 1933. ISIS

Contents: 1. Zeitschriften und Sammelwerke; 2. Allgemeines; 3. Biochemie; 4. Pharmakologie—Toxikologie; 5. Blut und Blutkreislauf; 6. Exkretion und Sekretion. Harn Nr. 1717-1731; 7. Bewegungsapparat; 8. Physiologie der Sinnesorgane; 9. Fortpflanzung und Wachstum; 10. Handapparate.

Goldschmidt, E. P. Classics of science, catalogue 29. 80 p., 4 pl., figs. London, W.1, 45 Old Bond St. (received October 1933). ISIS

Very interesting and instructive catalogue with many illustrations, 80 p. dealing with 220 items. G. S.

Goldschmidt, E. P. A collection of rare books illustrating the history of anatomy, biology, physiology and surgery. 33 p., 119 items, ills. London, W.1, 45 Old Bond St., 1933. ISIS

Goldschmidt, E. P. The Renaissance in France. Catalogue 31, 89 p., 296 items, 15 pl., fig. London W.1, 45 Old Bond St. (received February 1934). ISIS

The artists: G. TORY, ORONCE FINÉ, JEAN COUSIN; The writers: CHASTELLAIN, RABELAIS, RONSARD, BONNEFONS; The scholars: LEFÈVRE D'ETAPLES, BUDÉ, TURNÈBE; The printers: ESTIENNE, COLINES, VASCOSAN, DE TOURNES.

Grafton & Co. Books on many subjects. Catalogue 127. Coptic House, 51 Great Russell St., London, W.C.1, 1933. ISIS

Includes a collection of items concerning JOSEPH PRIESTLEY (nos. 690 to 732). G. S.

Grafton & Co. (FRANK HAMEL). Engineering (other than steam engineering) together with works on the iron & steel industries. Cat. no. 134. 76 items. London, W.C.1, Coptic House, 51 Great Russell St., 1933. ISIS

Grant, John. Medicine, natural history, travel and Americana. 70 p., 1746 items. Edinburgh, 31 George IV. Bridge, February 1934. ISIS

Laffitte, Louis. Sciences. Catalogue 62. Librairie ancienne et moderne. 1 Boulevard Garibaldi, Marseille, 1932. ISIS

Sciences physiques et mathématiques. Histoire naturelle. Agriculture. Médecine. En tout 1737 nos. G. S.

Laffitte, Louis. Catalogue no. 69 : Languedoc, Provence, histoire, géographie, folklore, beaux-arts, sciences naturelles, littérature, philologie, linguistique, dictionnaires, troubadours, Comté de Nice, Corse. 1550 items. 1, Boulevard Garibaldi, Marseille, 1934. ISIS

Leighton, J. & J. Catalogue no. 22 : Early books on medicine, surgery, anatomy, chemistry, physics, microscopy, etc. including Harveiana, bibliography, &c. 34 p. London, W.C.1, 100 Great Russell St., Bloomsbury. ISIS

Leighton Ltd. Catalogue no. 23 : A collection of works in most departments of the history of science and of medicine at moderate prices. 263 items. London, W.C.1, 100 Great Russell St. ISIS

Lier, R. Early books on medicine and natural sciences offered at adapted prices. Bulletin 19. 16 p., 146 items. Firenze-Galluzzo, via San Felice a Ema, 41, 1933. ISIS

Masson, Paul. Catalogue de livres anciens et modernes : ouvrages divers ; médecine ancienne — pharmacopée ; sciences occultes — Franc-Maçonnerie. 60 p., 835 items. Sceaux (Seine), 5, Avenue Jean-Racine, 1933. ISIS

Nourry, Emile. Médecine ancienne : anatomie, chirurgie, chimie et alchimie, sciences anciennes. Cat. no. 53. 81 p., 898 items. Paris, 62, rue des écoles, 1933. ISIS

Sotheran. Annotated catalogue of works on chemistry, pure and applied, no. 839. 2450 items. London, W.1, 43, Piccadily, 1934. ISIS

Contents : 1. History, bibliography & biographies ; 2. Early chemistry to LAVOISIER (alchemy, iatro- and phlogistic chemistry); 3. From LAVOISIER to 1850; 4. Modern chemistry; 5. Modern applied chemistry; 6. Periodical publications; 7. Rare and valuable works on mathematics, astronomy, physics, etc.; 8. Addenda.

Taeuber & Weil. Klassiker der Naturwissenschaften des XIX. Jahrhunderts. Liste 41. 23 p. München. ISIS

106 scientific classics of the nineteenth century with bibliographical references and many illustrations.

Taeuber & Weil. Optik. Microscopie. Liste 40. 23 p. München. ISIS

71 items described with bibliographical references and many illustrations. G. S.

Tregaskis, James and son. Old medicine and biology. An interesting catalogue of reasonably priced items, with a supplement of new medical books. Caxton Head catalogue 1008. 32 p., 216 items, ills. London, W.C.1, 66 Great Russell St., 1934. ISIS

59. — MEMORIA TECHNICA

Critical bibliography no. 40, *Isis*, vol. 22, 322-431, 1934. ISIS

This note is published at the end of our bibliography solely for the convenience of the scholars who cut out the whole or part of it, attach extracts to catalogue cards and classify. By adding this note to the others they will be able to find out rapidly whether this particular bibliography has been analyzed or not. G. S.

60. — ERRATA

Series 30

(For previous errata, see ISIS, 21, 475.*)*

Vol. 13, 374, l. 21. Instead of " nineteenth " read " twenty-ninth."
Vol. 19, 587, last note. NORTHROP's book was published by the Cambridge (not Harvard) University Press.
20, 306, l. 14. Read " retardation " instead of " decline."
l. 22. Read " Ajima " instead of " Yasujima."
l. 10 from bottom. Read " ALEXANDER WYLIE " instead of " WYLIE, ALEXANDER."

A few other misprints are not mentioned in these errata because they are too obvious to cause any error or confusion. I wish to express my thankfulness to the readers who take the trouble of making the above-mentioned corrections in their set of *Isis* and of the *Introduction*. I would advise them, after having accomplished that little task, to write their initials near mine at the bottom of this note to indicate that these and the previous errata have been taken into account. G. S.

These and the previous errata have been corrected by...

Index of Authors Included in the Fortieth Bibliography

The Roman figures followed by (1) or (2) refer to the centurial classification (Part I). Thus, Battistini, M., XVIII(1)D means that a paper by Battistini is listed eighteenth century, first half, subdivision D.

The Arabic figures refer to the historical and to the systematic classifications (Parts II and III) which are subdivided in sections numbered consecutively from 1 to 60. For instance, Duguet, le docteur, 14, 51, indicates that papers by Duguet are listed in section 14 (Islam), and in section 51 (Epidemiology, history of special diseases). F. S.

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